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The Car Ford Mouldn't Let You Have—and One They Might

All About the New '63 Outboards

The Operation That Couldn't Be Done

The Boy Who Lost His Arm and Got It Back



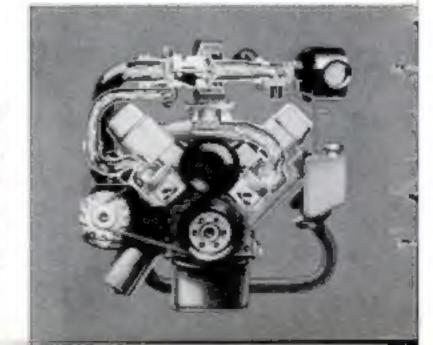
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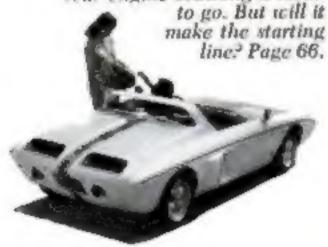
Art Production Manager Henry W. Kazmirowski

November 1962

A miracle? Maybe-but one that doctors have long dreamed of Here's the dramatic story of how Everett Knowles, 12, lost his arm and got it back. Page 71.



Ford's scrappy little rear-engine Mustang is rarin' to go. But will it





\$100,000 and a 100-year-old idea give Aereon III its lift. Page 60.

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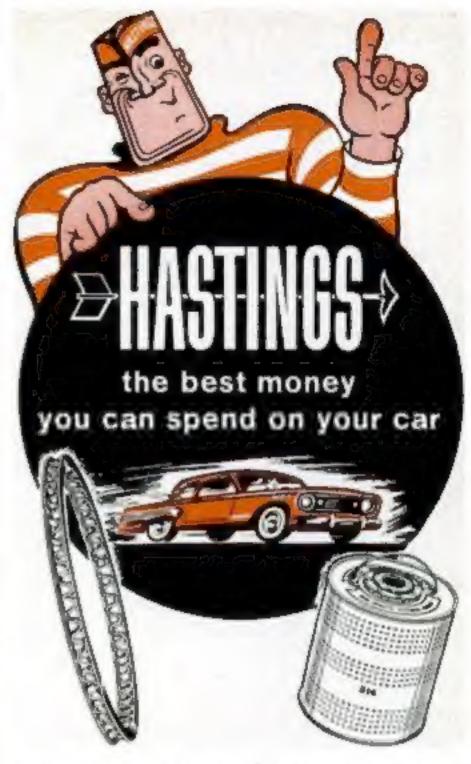
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PS readers talk back

Space Questions Bring Answers

I have read your fine article "Stupid Questions About Space" [Aug., p. 48] and I'd like to give my answer to one question: How

come the heat problem arises only upon re-

turn to earth?

Retrorockets for slowing a capsule out of orbit knock down its speed by only about five percent, so it starts re-entering the atmosphere at a 17,000-m.p.h. clip. Although continuously slowed by friction (not steadily accelerating, as you say), it is still ripping along—in the 50-down to 20-mile altitude range—many times as fast against terrific frictional force as it was previously traveling upward on its way through this same region. The rising rocket gains most of its speed in the nearly airless region above 50 miles high; the returning rocket loses most of its speed below that level.

C. R. RENNISON, Chicago.

... Add to your answer on how they steer a rocket: Jets on the outside of the capsule shoot out steam to guide and control the rocket. Thought you might like to know this for your next flight.

PHILIP SMITH, New Britain, Conn.

rockets and space was a honey. It brought to mind a wonderful sentence written by Alfred North Whitehead, the famous philosopher: "The 'silly question' is the first intimation of some totally new development."

JOHN WHITE, NYC.

High Cost of Doomsday

Congratulations on "Man's Last Blast" [Sept., p. 111]. It should be possible to construct a shelter against the doomsday bomb. It would need thermal insulation to keep out the heat. sealing to keep out the carbon monoxide from the fire, and equipment to remove carbon dioxide and replace oxygen from the air. Such a shelter, described in Civil Defense-1961 (U.S. Government Printing Office, Washington 25, D.C., \$1.75), can hold 100-200, withstand a blast overpressure of 35-lb, per square inch, and has a radiation-protection factor of 10.000. That means that a one-million-roentgen dose of radiation caused by the sodium-wrapped 20,-000-megaton bomb would be reduced to 100 roentgens-not enough to cause fatalities, Cost of the shelter would vary from \$103 to \$163 per person, depending on fixtures and number of shelters built. That's a high price to equip the whole U.S.A., but a worthwhile investment in case of nuclear war.

DAVID W. JOHNSTON, Washington, D.C.

blasts near the poles might tip the earth's axis and move the earth into a new orbit was first put into writing by Jules Verne in his story of the purchase of the North Pole. That was in the 1800s.

M. J. ZEMAITIS, Cheltenham, Pa.

Howls from the Hams

While reading "How to Track Down TV Interference" [Aug., p. 121], I came to the con-



clusion that you have something against us hams. In the discussion on methods of tracking down an offending signal, you threw a number of types of signals under the classification "illegal transmission."

While it is true that ham and other signals

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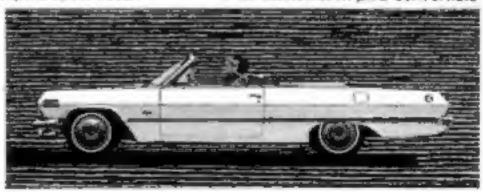


* 63 Cheurolal Rai Air Station Wagon

4 '62 Chevrolet Impala Sport Series

▼'63 Chevrolet Impala Convertible





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It's Chevy Showtime '63! Come to the



Hard to believe, but this year's Chevy II is better than last year's. It shares the new easy-care features of the big Chevrolet and adds its own attributes of parkable size, four- or six-cylinder economy, and interiors that'll match cars with twice the price and half the charm. If you want maximum car for minimum dollars, Chevy II is your car. . . . Chevrolet Division of General Motors, Detroit 2, Mich.

'63 Chevy II Nova 400 Sport Coupe



Change it? Calm yourself, nobody's going to mess with a winner like this one! We did add self-adjusting brakes and a more fully aluminized muffler; interiors are refined a bit, and you'll notice some trim changes, but the rest is pure untampered-with Corvair with all the over-the-road goodness that implies. Oh yes, we changed the rings around the tail-lights so all those people you pass will know you're driving a '63.

*63 Corvair Monza Convertible



Go Show at Your Chevrolet Showroom

may cause TVI, this, as often as not, is not the case. It is not uncommon that a detector located near the TV is breaking a ham signal into harmonics. A number of situations may cause the formation of a detector circuit; among the most common, a loose or rusty connection to the TV antenna. Many a ham takes pride in a perfectly shielded rig with a grounded chassis and a harmonic-free signal feeding a low SWR feedline and antenna.

This explains why a ham, whose own TV set is not interfered with, gets complaints from neighbors several hundred feet away. Obviously the fault is in their TV sets. For the record, the amateur is legally "clean" if he doesn't interfere on his own TV set.

J. MICHLIN, NYC.

... Art Margolis gives a scheme for locating "illegal transmission" by direction finding, then goes on to say that after the source has been located, "it's a matter of diplomacy or a report to the FCC."

Mr. Margolis never mentions that there is no possibility of making valid TVI measurements with a set that's not equipped with a high-pass filter. Yet the FCC will take no action against an amateur if the only TVI complaints are from owners of sets not so equipped. Manufacturers are required by federal law to equip all new sets with these filters and provide them free of charge to owners of older sets when interference is a problem. Quite often it is the fault of an easily overloaded TV set-the responsibility of the set's owner, not the amateur involved.

STUART E. SCOTT, Kent, Ohio.

Needling the Designers

So-the "Falcon Goes Convertible" [Sept., p. 55]. I own a '60 two-door Falcon, and wondered why they didn't include a convertible. So I sent the Ford people a picture



of my model version last summer. They promptly returned it-now I know why. M. J. WAGNER JR., Baltimore.

Giving Gus a Hand

I always read "Hints from the Model Garage" first because I find lots of helpful ideas CONTINUED

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8 POPULAR SCIENCE NOVEMBER 1962



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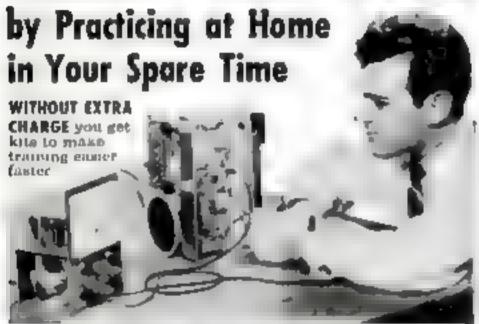
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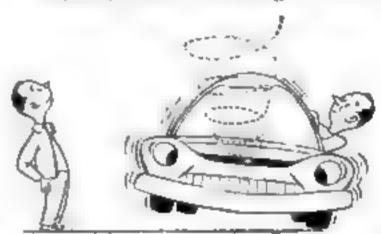
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in them. In August [p. 158], however, I noticed one that could lead to trouble,

You suggest cranking the engine to "pop" off a stuck head, after removal of all nuts or head bolts, but with spark plugs left in to provide sufficient compression (as pictured in the drawing, but not stressed in the text).

I've used this method for some time and suggest that two head bolts remain very loosely threaded into the engine block on a V-8 or V-6. On V engines, there is nothing to hold the



head in place once the compression "pops" it loose. If the head falls off the block, it can be badly damaged.

DUANE GOODNESS, Great Falls, Mont.

. . . Thought I'd make that gadget for draining crankcase oil from the top [Aug., p. 160]. I'm finding it hard to drill a %-inch hole in a 3/16-inch spacer, but I'm still trying.

ROBERT AGUIRRE, Inglewood, Calif.

Somebody received the figures.

Debate on Fluoridation

When I eagerly read about the vitamin drops to stop tooth decay ["March of Science," Aug., p. 13], I expected scientific facts. Instead I found that it isn't the vitamin drops that stop tooth decay: it is Adeflor. The author calls people who oppose the fluoridation of public drinking water "vociferous zealots (their arguments are complex and often devious)."

I am one of the vociferous zealots. Are the arguments too complex for him to understand? Certainly we are no more devious than he is. Nowhere on the page did I see the words. "This is an advertisement."

HESTER ROBINSON, Fredmont, Calif.

. . . Martin Mann does not say that dentists. doctors, and government agencies have endorsed Adeflor, but it certainly is implied. The exact facts as stated in the 1962 Accepted Dental Remedies, published by the Council on Dental Therapeutics of the American Dental Association:

"There is a more recent trend to combine vitamins and sodium fluoride in fixed combinations in supplements for infants and very young children. These products are not regarded by the Council as rational combinations because of the difficulties involved in their proper use."

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A.D.A. so we are justly disturbed by this article, which would make it appear that Adeflor is the only fluoride product for such use.

HOWARD D. VOCT, PRES. Fluoritab Corp., Fluot, Mich.

... Would you look into the reason for requiring a prescription for vitamin pills "spiked with sodium fluoride" and, on the other hand, urging the population to consume sodium fluoride (through the public water supply) in amounts that could vary widely depending upon the amount of water consumed by the individual?

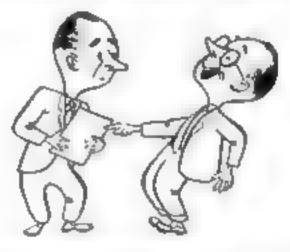
JEAN E. MITCHELL, Shreveport, La.

There is a Tide . . .

That road map geared to a speedometer ["PS Picture News," Sept., p. 117] may be new in Britain, but I recall seeing a similar device in New York City 25 years ago. It was invented and patented by a man named Tsagris. He called it an Odolog, a composite word from the Greek meaning road log. No doubt his invention could be found in the U.S. Patent Office files.

E. B. CAPRON, Woonsocket, R.I.

unhappy. About eight years ago, I had the same idea and made a drawing of it. A "pattent engineer" gave me a good report on it, but I didn't have the money to patent it at the



time. I told my brother about it and he just laughed at it.

Just goes to show you. Don't let anybody put you off a good idea. Do something about it. E. J. RATZ, St. Louis, Mo.

Troopers' Driving Tricks

"Could You Drive Like a Trooper?" [Aug., p. 85], mentions a book called *Pursuit Driving* by Lieut. Ed Jones. Could you tell me where I could obtain a copy?

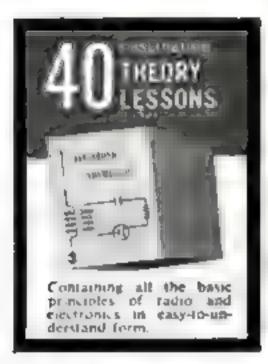
STANLEY KRIDER, Columbia City, Ind.

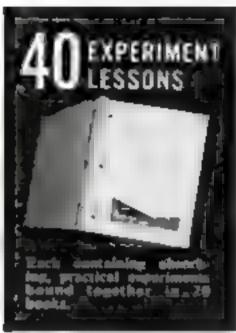
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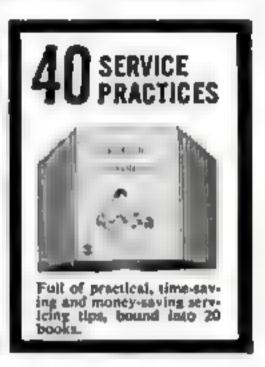
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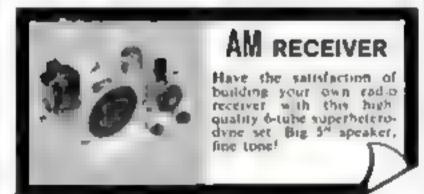
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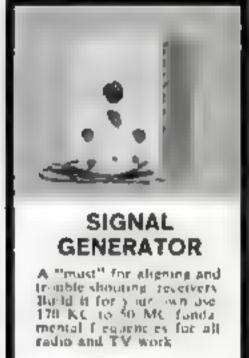
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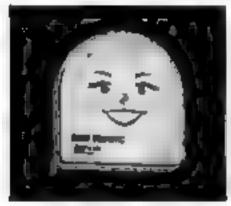
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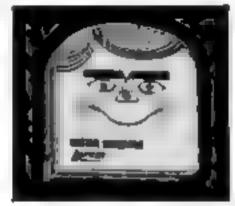
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attended some time ago, all this information was presented. However, I feel sure that reprints of your article would be helpful to any law-enforcement department.

Congratulations to your magazine and E. D. Fales Jr. for a feature full of facts and very well presented.

ATWELL D. BERRY, Old Town, Me.

Accolade for Bill

What you say about your chief photographer ["My Best Photos for PS," Sept., p. 93], who is retiring, must certainly be true. The photo of the huge iceberg framing the icebreaker East Wind (an eye-catching comparison shot) is a wordless example of his genius with a camera. You are certainly losing a talented artist.



A. B. PACKMAN, Philadelphia.

Warning for Glass Painters

Just read about the new liquid plastic for tinting clear glass on an enclosed porch or patio ["What's New in Home Improvements," Sept., p. 192]. Some insurance companies won't insure tinted or painted glass. It absorbs more heat and sometimes breaks. The new alkyd-base plastic may be acceptable, but it's best to check.

SIDNEY HILTY, Findley, Ohio.

This Way Back-for Campers

So Peter Legon ["PS Readers Talk Back," Aug., p. 4] thinks campers are getting soft? The Boy Scouts of America still carries on an extensive camping program without the use of portable TV sets, motorized reels, and other such luxury items. If he'd like to see camping as it was when he was a boy, I suggest he join a scout troop as an assistant scoutmaster.

BILL AUMEN, Ft. Walton Beach, Fla.

The Glorious Old Turkey

As any Navy man can tell you, that glorious old "turkey" John Streeter flies ["I Dive-Bomb Forest Fires," Aug., p. 82] never saw a Martin factory. It originally was a TBF built by Grumman. Those carrying the TBM designation were built by General Motors. In fact, all the turkeys I took care of 12 years ago were GMs.

To clarify the M designator: It does stand for Martin in the case of these patrol bombers: P4M "Mercator," P5M "Marlin," P6M "Seamaster," and JRM "Mars." All are seaplanes. The P6M, a jet, never saw large production.

T. V. PARKER, Tulsa, Okla.

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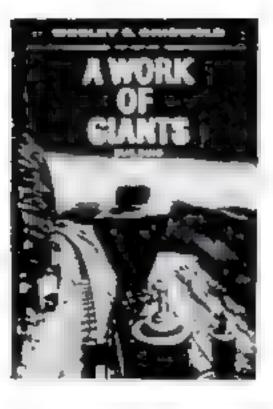
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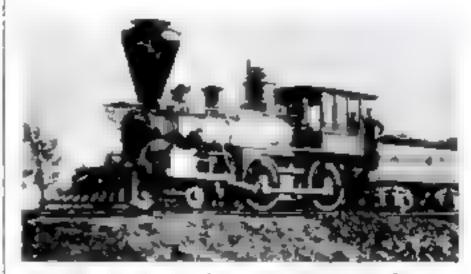
The story of the race to build the first cross-country railroad



BEGUN 99 years ago, the first transcon-tinental railroad was a wonder of its age. It spanned two-thirds of the nation, crossed prairies and deserts, bridged rivers, climbed and tunneled mountains. Remarkably, it was built with almost no power machinery—just human and animal muscles. More than 10,000 Chinese labored for the Central Pacific, one of the two lines that raced to meet in Utah.

Grading and filling was done with horsedrawn carts. Blasting holes were handdulled for the black-powder charges. (An exciting, tricky new explosive called "nitroglycerine" was tried occasionally. It shattered rock wonderfully-and some blasting crews as well.)

This fascinating story, including tales of raiding Indians and political shenanigans, has been told fully for the first time in A Work of Giants (McGraw-Hill, \$6.95). Its author is Wesley S. Griswold, West Coast Editor of POPULAR SCIENCE. As a seasoned traveler for the magazine, Wes Griswold got a close look at the wild country through which this epic railroad was built. His book is a five-year labor of love.



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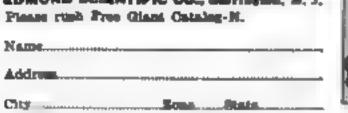
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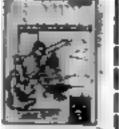
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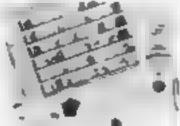


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The march of SCIENCE

By Martin Mann

Is there water in the seas of the moon?

The most valuable discovery that the astronauts could make when they land on the moon—better than gold, diamonds, or uranium—is plain old water. Its hydrogen and oxygen (separated by sun-generated electricity) would provide air to breathe, electric power (by way of the fuel cells), and rocket fuel. With water, the moon would become a useful colony and priceless space service station. Long-range spaceships could blast off from

earth with light fuel loads and fill up their tanks on the low-

gravity moon.



PHASE 1



PHASE 2



PHASE 3

Lunar pool may develop like this, from molten lava. With cooling, crust forms and seals m gases (volatiles). Water may be found here.

Astronomers have long thought that the moon was drier than Death Valley. But now comes Dr. John W. Salisbury, an Air Force expert on space exploration, to say maybe there is some water up there. And where does he suggest prospecting for it? In the maria, naturally. (Maria—Latin for "seas"—is the name ancient skygazers gave to the moon's shadowed areas, which look vaguely like earth oceans; these areas are now believed to be dried-up lava pools.)

Dr. Salisbury makes a convincing argument for a wet moon:

1. Three years ago the Russian astronomer Kozyrev startled scientists by spotting wisps of gas leaking out of a moon crater. Most likely this gas (an unearthly form of carbon) came from the chemical action of water on calcium carbide.

2. The odd "chain craters" that run between the ordinary craters on the moon are almost

certainly blowholes from old volcanoes. What gas popped them out? Well, in earth volcanoes, steam usually does that.

3. The bulges and wrinkly ridges on the lunar surface look like rock that has swollen as its mineral crystals absorbed water.

The moon has so many ridges, domes, and chain craters that there must once have been a lot of water present. Much of it should still be left, Dr. Salisbury argues, trapped under lava crust at the edges of the maria. Somebody is going to find out for sure within a few years.

Human sonar

People may be as smart as bats and porpoises after all. At least blind people. They are remarkably skillful at the bat's and porpoise's sonar-like trick of "seeing" with sound echoes. So concludes porpoise expert Prof. Winthrop N. Kellogg of Florida State University, who introduces his report in the journal Science by ruefully eating his own words. He writes, "With some embarrassment, I quote a recent statement of my own: The avoidance of objects by the blind appears to be very crude . . . compared . . , to bats.' The present article . . . shows just how accurate the echo ranging of experienced blind people can be."

Professor Kellogg tested two graduate students who had been blind for several years but got around by themselves very capably. He placed disks of different materials and sizes at varying distances in front of the blind students, and asked them to distinguish among the disksbut did not tell them how to do it. The students made noises: They clicked their tongues (like porpoise "pings"), snapped their fingers, hissed, and whistled. But mostly they talked. One sang the scale, or said, "Now, now, now, now" as he varied the pitch of his voice (some sharp-shooting bats use frequency modulation-FM). The other student just talked to himself out loud. Both turned their heads back and forth as much as 45 degrees (bottlenose porpoises do that; it accentuates the difference between the echoes received by the two ears).

Both these blind students could "see" accurately with their ears. They judged distance better than a sighted person using one eye. One of them could tell when a one-foot disk was moved four inches. They had no trouble distinguishing hard materials from soft (even denim from velvet), but did confuse wood with glass or metal.

Not all blind people are as talented human sonars as Professor Kellogg's students or the blind boy who rode his bike around the neighborhood, clicking as be wheeled. The skill must be learned. Two sighted students, put through the same tests blindfolded, instinctively imitated the blind technique of talking, and head-turning, but got nowhere.

Redesigning plants

Prof. James Bonner of Caltech has outlined a new plan of attack on the ancient and rapidly worsening problem of growing enough for everybody to eat (world population has zoomed past 3,000,000,000 and jumps another 50,000,000 people every year). His idea: Work on the basic process of photosynthesis that manufactures food from carbon dioxide and sunlight.

Green plants are distressingly inefficient. Even where there is plenty of water, rich soil, and expert farmers (Japan and Denmark), the very best rice and wheat fields convert only two to five percent of the incoming sun energy into edible calories. The way engineers figure efficiency, that's even worse than the gasoline engine, which is a wasteful machine itself.

Professor Bonner pinpoints two troubles:

 Not enough raw material—carbon dioxide—gets through the plant leaves.

2. The food factories—chloroplast cells—inside the leaves are set up for higher efficiency (but lower total output) in weak light, become less and less efficient as the light brightens.

Problem No. I might be solved by breeding plants with leaves that conduct carbon dioxide gas more easily. Problem

No. 2 is more complicated.

Each chloroplast contains more than 2,000 light-absorbing chlorophyll molecules connected to every active chemical center that processes carbon dioxide. But only a few molecules—around 10—have to absorb light to make a center work. This is fine in weak light. A little



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The March of Science . . . continued

energy falling anywhere on the leaf operates the factory. The shaded leaves at the bottom of the plant contribute their share to production, and cloudy days are not disastrous. The drawback is the terrible wastage of bright sunshine. It floods nearly all the chlorophyll molecules with energy, and more food-making power is available than can be used by the active center.

The way around this problem, Professor Bonner says, is to breed plants with "modulating chloroplasts," They would contain more than the usual proportion of chemically active centers to increase efficiency in bright light. But the real trick would be to make the connections between active centers and chlorophyll molecules adjust themselves automatically. In bright light, all centers would be connected up and food manufacture would hum along. In weak light, most of the centers would be shunted out of the circuit, leaving large light-collecting leaf panels made up of many chlorophyll molecules all supplying a few hardworking centers.

Would such a plant-breeding job be possible? Very difficult, thinks Professor Bonner—but worth trying.

Clean wash is still dirty

Laundering clothes at home may not kill all the germs in them, even when hot water and disinfectants are used. Dr. Ethel McNeil of the Department of Agriculture did the laundry for nine families for several months in her laboratory. After the clothes came out of the machine she found in them bacteria that cause boils, intestinal and urinary-tract infections, pneumonia, and ear aches. Sometimes the disinfectant would kill off the germs in the rinse water—but not in the clothes.

Hanky-panky among the birdwatchers

Over in England, where birding is a deadly serious occupation, cheating on "sightings" creates as much stir as throwing a World Series game would here.

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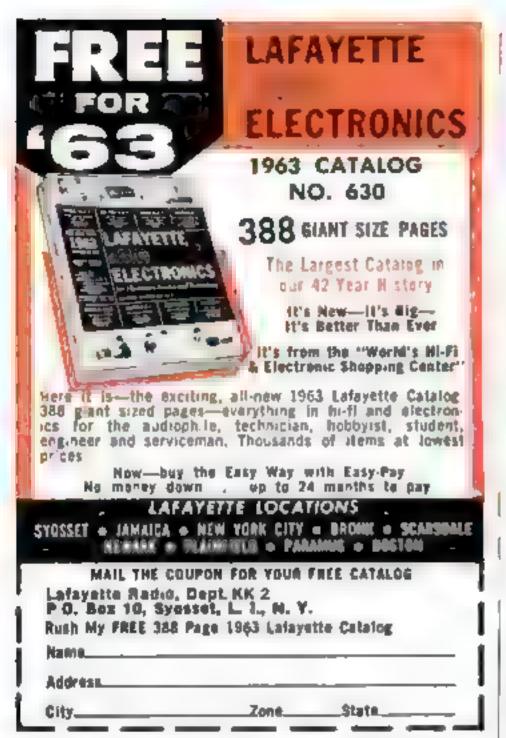
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The March of Science . . . continued

One of the leading journals blew the lid off recently. It charged that some of the most famous finds before World War I were as phony as a four-legged chickadee. They were very rare birds—slender-billed curlews, masked shrikes, gray-rumped sandpipers—that somehow seemed to be collected only by clients of one dealer. The man died 20 years ago, but the experts now think he smuggled the birds in from abroad—dead but fresh-frozen.

Old plagues never die

The United Nations is planning an allout campaign to get rid of smallpox in Brazil, one of the last areas in the world where it is common. This will be welcome news to American air travelers. who were bracing themselves for vaccination and revaccination every time they stepped off a plane. Last summer's smallpox scare-triggered by the homebound son of a missionary who exposed hundreds of U.S. and Canadian citizens before his illness was diagnosed—had public-health officials needle-happy. One day they quarantined a whole planeload before they figured out that the sick baby aboard was suffering from nothing more deadly than heat rash.

Smallpox is almost unknown in the U.S. (mainly because vaccination is an entrance requirement for kindergarten). But this childhood vaccination wears off, leaving many Americans as vulnerable as the Indians were when Columbus landed. The re-introduction of a disease that has been missing for generations may mean disaster. Only 15 years ago a Mexican merchant carried smallpox into New York and 12 people died. Yet universal vaccination is no panacea either. British doctors are opposing their government's proposal to vaccinate all infants. They point out that reaction to the vaccination would probably kill an average of 30 English babies a year-far more than would die from smallpox, if the public-health officers keep sharp eyes on those incoming airplanes. 🔳 🔳

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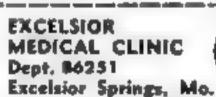
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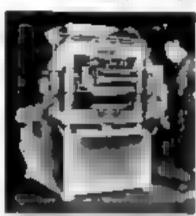
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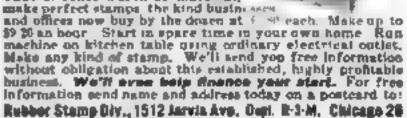
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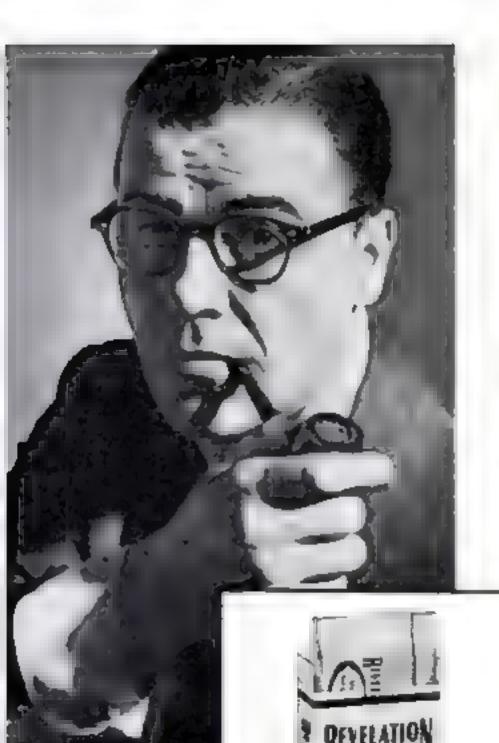
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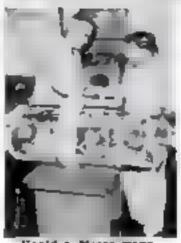
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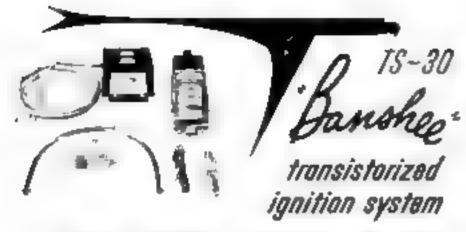
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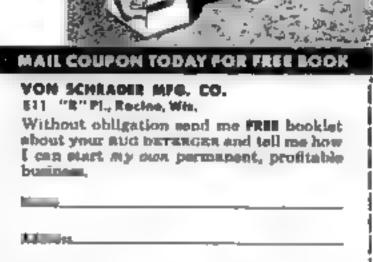
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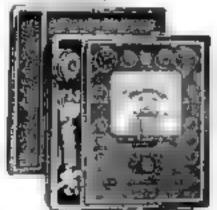
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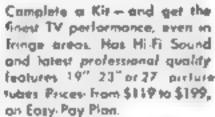
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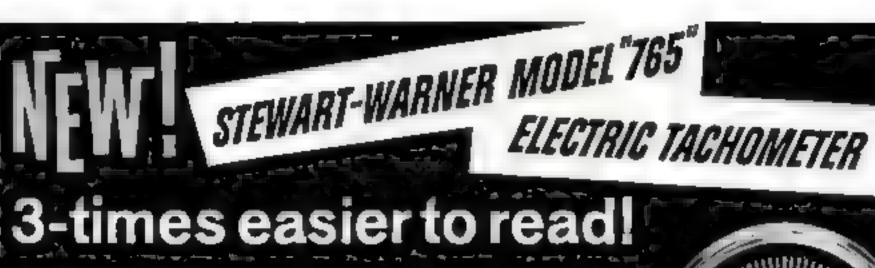
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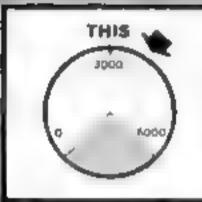
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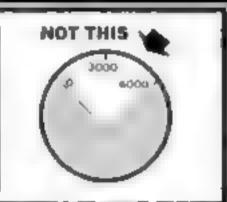


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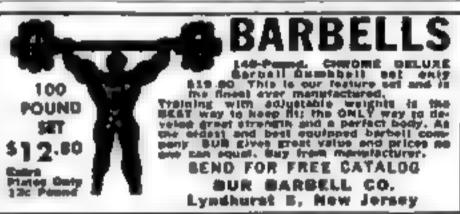
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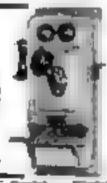
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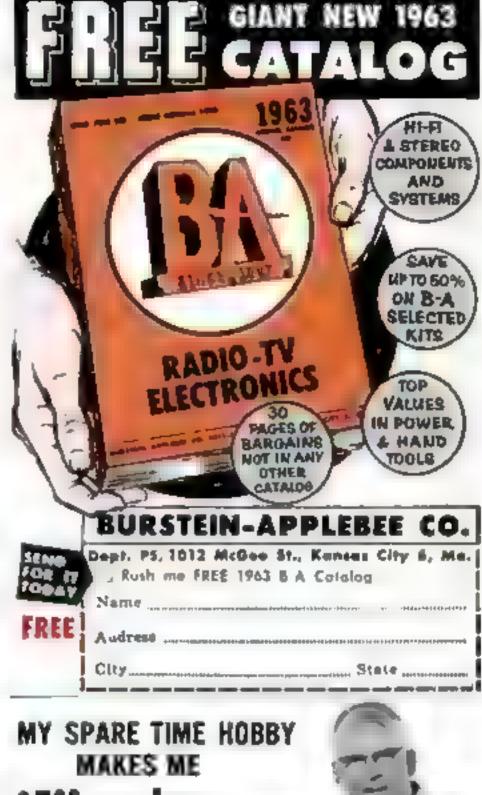
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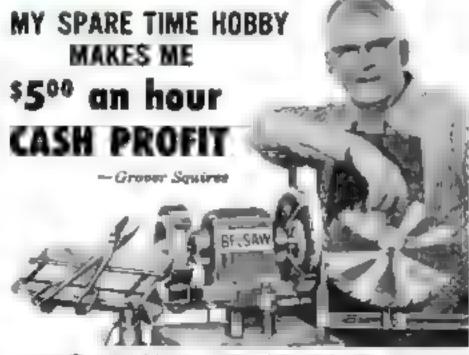
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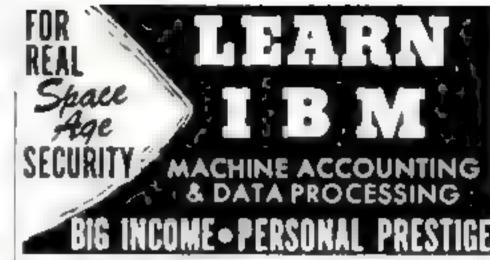
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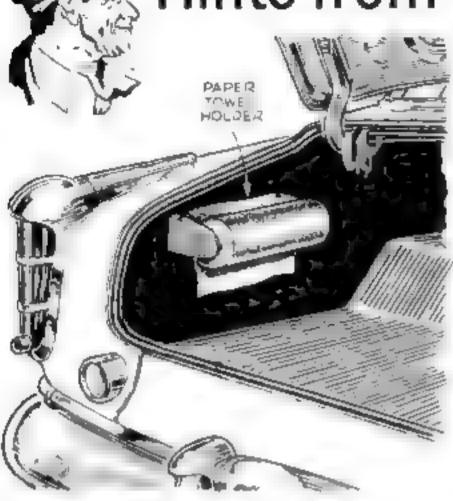
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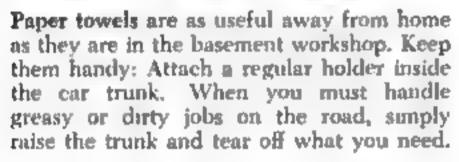
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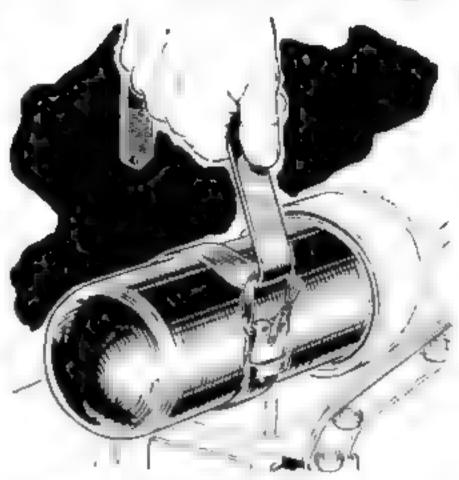
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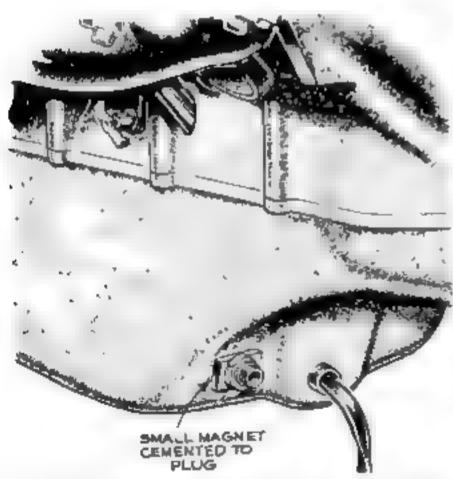
Hints from the Model Garage



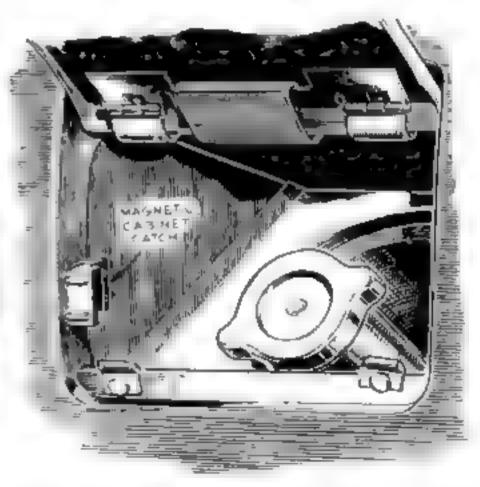




Changing a throw-away oil filter can mean a lot of struggling. Try using an old leather strap and buckle to remove it. Just slip the looped belt over the filter, tighten it up, and lift it out. The tightened strap will keep it from slipping.



Let magnets work for you. They are simple little assistants, often overlooked. You can hang up items with them, use them as hold-downs for loose papers, or cement them on equipment as graps. For instance, it's easy to misplace the drain plug when changing



oil. By cementing a small magnet to the plug, you can keep it beside the drain hole. Or, if the gas-tank lid fails to close, buy a magnetic door catch. Drill two holes inside the gas well, then attach the catch so the lid touches the magnet in the closed position.



Pontiac Motor Division - General Motors Corporation

*Optional of antra cost

"Don't tease the pretty panther, Clive."

We drew our new Grand Prix low and sleek and road-hungry on the drawing board, and son of a gun—it came out that way in the metal! And on the road, a nicer thing couldn't happen to a Pontiac-watcher.

With the looks coming through loud and clear, we concentrated on making the car driveable. What's our idea of a driveable car? One with steering and suspension that accept a "that-a-way" command without arguing the point. One with pedals, levers, switches and knobs that are placed just so and work right now. (A steering wheel adjustable for height and rake helps, too." Ask Clive.)

What's connected to the right-hand pedal is between you and your dealer. We will say this: the result of pressing that pedal will range from mere bravery to a reenactment of the charge of the light brigade. The lever between the bucket-type seats connects to a choice of Roto Hydra-Matic* or 4-speed floor shift.*

Now for the final connections: Your hands to the wheel and your er, nether region to the driver's seat. The keys are tinkling in your dealer's hand. Watch his hand twitch. He's driven one.

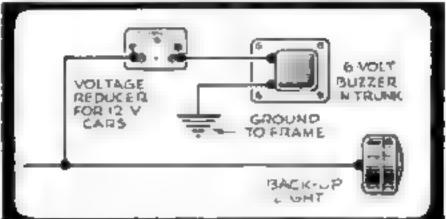
Wide-Track Pontiac

More Hints from the Model Garage

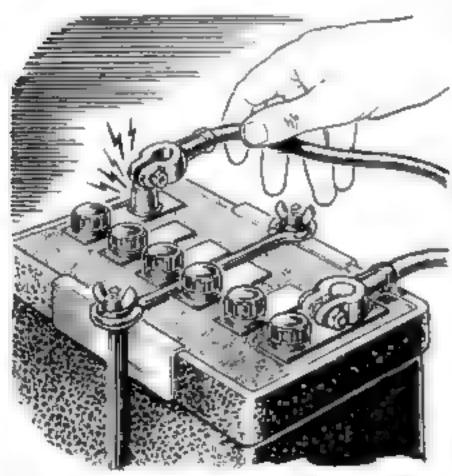


To apply car wax, put it in a plastic squeeze bottle of the type some hand detergents come in. While one hand is squirting the polish, the other spreads it. This speeds application and eliminates accidentally overturning a standing container.





When backing up, you can alert children with this alarm: Add a six-volt buzzer to the car's electric system by mounting the unit inside the trunk and connecting it to the back-up circuit. The buzzer will sound when the car is in reverse.

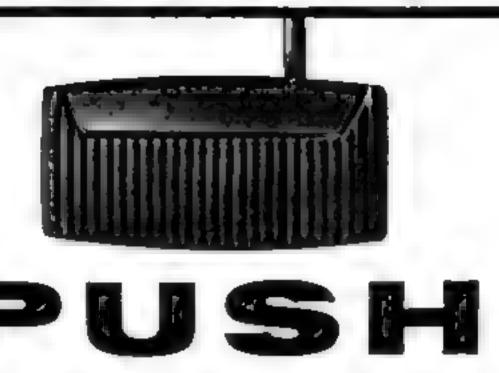


If the battery runs down frequently, you can suspect a small but constant current drain. This is checked by disconnecting one battery cable and touching it against the terminal. A tiny spark indicates that current is flowing. Check all wiring.



An old pair of slip-joint pliers makes a dandy tool for removing spring-type radiator-hose clamps. Notched as shown, it will hold a clamp without slipping. And you can work the pliers at various angles in those difficult or tight locations.

Two simple exercises that can add years to your life



This evening, while at home, get into your car and push the brake pedal. Have someone in your family make sure both your stop lights are working. If one is out, replace it tomorrow. You'll make it easier for the other driver—safer for yourself.



Then pull the light switch. Make sure all your headlamps (don't forget the upper beam) and your rear lights are working. And while you're at it, check your turn signals. These Push-Pull exercises will do you good—especially if you find a burnout. It's very possible you will—because one out of every six cars needs a new bulb.

When you find a burnout, replace it with a dependable General Electric lamp, the brand most people prefer.

Miniature Lamp Dept., Nels Park, Cleveland 12, 0.





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Detroit report

By Devon Francis



Willys' Wagoneer

A Jeep in name only

When Willys Motors trotted out its new Jeep Wagoneer at the Detroit Auto Show last month, the occasion marked several firsts for the company. It was the first time since 1955, when Willys abandoned its "Aero" line of sedans, that the Toledo plant could boast of a genuine passenger wagon. All the company's vehicles meantime had been classified as commercial.

The Wagoneer is the first U. S. passenger car to offer an automatic transmission with a four-wheel drive, and the first with an overhead-cam, six-cylinder engine.

The Wagoneer is a radical departure from anything that Willys has marketed in these last few years. It's sleek. Its lines flow. The company is at pains to point out that it has little in common with the famous Jeep but the name. Toting six passengers, it is available in either two- or four-wheel drive, with two doors or four doors, and in standard or deluxe versions. The engine turns out a respectable 140 hp. Wheelbase is 112 inches, overall length 183—about that of the smaller U. S. compacts.

A limit to engine size?

Two bits of news were bracketed when the bulk of the 1963 models were announced in September. One was that American manufacturers probably are going to limit the piston displacement of

their engines to 427 inches from now on. That's not as puzzling as it sounds at first hearing, despite the renewal of the "horsepower race."

The other bit of news—as described in Popular Science's auto section in October—was the announcement of optional transistorized ignition.

First, about the limitation on cubage: Ford is known to have been experimenting with an outsize power plant of 483 cubic inches. Pontiac is rumored to be testing an engine in the same bracket, and Chevrolet's got one in the 450-mch range. These engines may be junked. The reason: The National Association of Stock Car Auto Racing, National Hot Rod Association, and American Hot Rod Association—all sponsors of racing events -have a 427-inch limit on engine size. Detroit's big engines, experimental or in production, are actually intended for racing. The auto makers like to win races. Helps sales. But if they can't race those monster engines, they may not make them.

How does transistor ignition tie in with the cubage limit? Here's how. The standard battery-coil-breaker-point system will deliver only about 400 sparks per plug per second. At 6,000 r.p.m. the ignition is getting on the outer edge of its performance. A magneto does better—producing about 500 sparks per second. But there is practically no limit to the number of sparks to be drawn from a transistor—and good, hot ones, too.

The higher the r.p.m., the higher the engine's power peak. So transistors will produce more from 427-inch engines than conventional ignition systems.

For 1964: a new Bird

With the 1963 cars still warm from the stamping mills, how would you like a peek at 1964? The T-Bird will be all new. Interiors will be revolutionary, with "cove seats" integrated into the sides of the car . . . In '64 at least two more cars will offer disk brakes—the T-Bird and Chrysler's turbine-powered car, which currently bears the name of Typhoon.



BRAND NEW ECONOMY CAR

THIS 1914 MODEL T FORD GETS BETTER GASOLINE MILEAGE TODAY THAN WHEN IT WAS BUILT. HOW ABOUT YOUR CAR? Forty-eight years ago this Model T get 18 miles to the gallon of gas. Today, thanks to better gasoline, better ignition, it gets 19 miles to the gallon. What's the point? Just this. Almost any car can be an economy

car if you'll only give it a little help.

How? Easy, Just drive "Old Faithful" down to see the guy who sells Autolite parts. He's got a whole shelf full of nifty items that will make any moother a miser in the miles-pergallon marathon.

Spark plugs that clean themselves while you drive. Factory-quality tune-up

parts. Sta-ful Batteries that offer up to three times the protection against dry-out failure. And a friendly way of doing business that is every bit as economical as it is efficient.

You'll find help like this at your nearby garage or service station, Just drive in and tell the man Autolite sent you. He'll know what to do.

SPARK PLUGS - BATTERIES - SERVICE PARTS

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THE NAME TO REMEMBER WHEN YOU CARE FOR YOUR CAR

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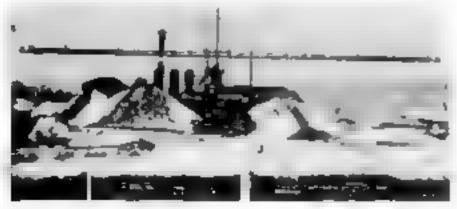
1872 "The life of a lady dying from haemorrhage was saved by the transfusion of blood, by what is known as the 'immediate' method, Dr. Aveling reports that blood was pumped from a vein in the arm of a man, into a vein of the lady's arm, without exposure to air and in a duly-regulated stream. In a few hours consciousness returned, the patient took nour-ishment, and afterward fully recovered."

"In his valuable paper On the Ecil Effects of the Use of Arsenic in Certain Green Colors, Dr. Frank W. Draper gives the following, among other startling cases of arsenical poisoning from green-colored pa-

per-hangings:

"In 1862 a case of fatal poisoning occurred in London, the victim being a child. In the course of the investigation it transpired that four children had died within two months under exposure to the poison contained in the paper-hangings of the room they occupied. The green stain came off on the hand like paint. Three grains of arsenic were found in a square foot of the paper."

1902 "Easily the most remarkable of all cranes yet constructed are the great balanced cantilever cranes invented by Alexander Brown, an American. The cantilever crane is the most perfect machine yet devised for use in handling armor plate and other heavy parts. By means of a trolley and hoist block, mounted on the cantilever, the load can be hoisted from the ground and traversed from one arm of the cantilever to the other, the base of the crane being so arranged that the load passes through it."



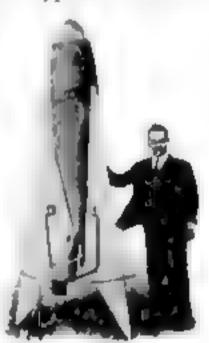
"Lord Rayleigh—perhaps one of the greatest physicists now living—presented a paper at the 72nd annual meeting of the British Association at Belfast. He discussed the question of whether motion through the ether causes a double refraction of light. He reviewed the evidence which has led physicists to conclude that the earth in its motion does not drag the ether with it.

"Lord Rayleigh's experiments have confirmed those of our American physicists Michelson and Morley which showed that light travels through a body traversed by a stream of ether with the same speed

along it as against or across it."

1932 "Streamlined like an airplane bomb, a new type of rocket

[right] will soon be shot at the stratosphere by Johannes Winkler, German experimenter. Recording instruments on an automatically released parachute will bring back data for study. A lonely section of the Baltic coast has been chosen for the test. The rocket will have to reach a height beyond seven miles."



"Dr. Theron W. Kilmer, at a National Identification Association convention, told police of a 'criminal ear' that appears twice as often among gangsters as among honest citizens.

"The doctor examined hundreds of photos of criminals and honest men and found that 23 percent of the honest persons had flap ears while among criminals the aver-

age was 44 percent.

"Dividing the known hardened criminals according to the crimes for which they were sentenced, he found that nearly 64 percent of auto thieves had flap ears; more than 50 percent of stickup men; 48 percent of burglars; and 45 percent of jewelry thieves."



INCENSE

CEDAR



Get ideas from this FREE booklet (available now at your building supply dealer's). Add to your home's value, increase its livability with attractive, practical built-ins. Here are easily-followed construction plans for many ways to increase the useful space within your house . . . room dividers, under-the stairway units, closet suggestions and many others. If your dealer is unable to supply you with this booklet, send 10c to the address below.

Western Pine Region Solid Lumber will add both beauty and value to your project . . . and these woods are a joy to work with . . . the world's best for sawing, shaping, sanding and finishing.

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NOW-PICKUPS UN



Only Ford offers so many different kinds of pickups... so many body styles, capacities and power choices to custom-fit your pickup needs!

NEW FORD

For doing a job in style, Ford's Ranchero is in a class by itself! In styling, comfort, handling ease and economy, it's a '63 Falcon car. For work, a sturdy 6-ft. pickup with 800 lbs. capacity. Great for business, perfect for personal transportation.

NEW FORD

Solid comfort in the cab, solid truck underneath. Built like big trucks for greater durability... Ford conventional pickups use the same type of axles, frame, springs you'll find in big trucks. 6½, 8, 9-ft. bodies; GVW's up to 7,800 lbs. Flareside bodies, too.

LIMITED FROM FORD!

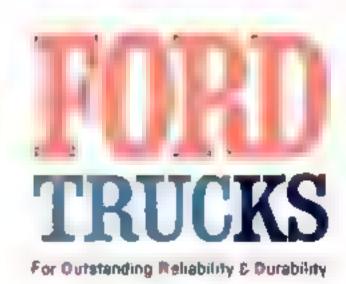


NEW FORD

No other pickup offers you such a combination of capacity and economy! Ford's Econoline takes payloads over ¾ ton in its big, easy-to-load 7-ft. box. And, thanks primarily to its thrifty Falcon engine, it can cut operating costs \$100 in a 16,000-mile year.

NEW IDEA!

Ford's new Econoline Van gives you 204 cu. ft. of loadspace under lock and cover. Big 4-ft. door openings at side and rear (both sides if you like) make loading practically as easy as in a pickup. All at a price below some open pickup prices!







so downright smokeable!

For flavor and enjoyment you just can't beat Pall Mall's natural mildness. It's so good to your taste. Never too strong. Never too weak. Always just right! Enjoy satisfying flavor...so friendly to your taste

Outstanding . . . and they are Mild!

Regular

Filter-Tip

PALL MALL

Smoke "traveled" through fine tobacco tastes best. Pall Mail's lamous length travers and gentles the smoke naturally over, under around and through the finest tobaccos money can buy Makes it mild ... but does not fifter out that satisfying flavor!

C . C. Protect of The American Foliami-Congracy "Toliami to see milite name"



60-Knot Hydrofoil

90 Tons of Get-Up-and-Go!



The fastest ship afloat will open a new era of high-speed ocean passenger service

By Alden P. Armagnac

STARTLED beachgoers on Long Island Sound have been blinking their eyes at a white-and-gray blue-striped nautical apparation

With a thunderous roar and a faint trail of jet-fuel smoke, the extraordinary 104-foot vessel pictured above has been



Fastest ship in world, Denison has surpassed designers' 60-knot rating by actually hitting 63

knots (72% m.p.h.) in trials. At high speed, above, hull clears water's surface by five feet.

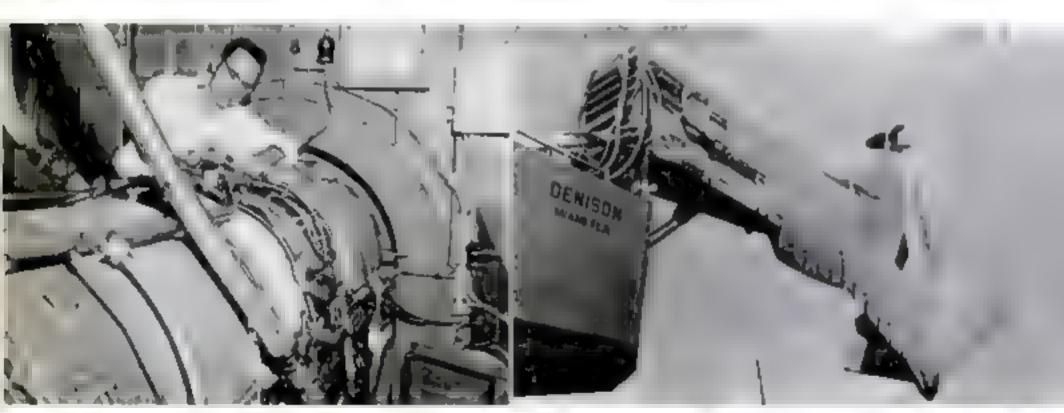
Sea trials groom the Denison for high-speed passenger service,

streaking by at an incredible 70 m.p.h. and more. As if to show it is really a ship and not some kind of waterborne missile, it has been seen executing graceful S-curves and U-turns at high speed, in a shower of spray.

The flying phantom ruffles the water so slightly, despite its express-train velocity, as only gently to rock the smallest boats nearby. Onlookers at close range see that the speeding craft's whole hull is out of the water-supported in midair by stiltlike appendages that dip below the surface on each side and at the stern.

Long Island's mystery vessel is the fastest ship in the world—long a dream, now a throbbing reality of aluminum and steel. Named the HS (for "hydrofoil ship") Denison, she's the first of a new generation of big U. S. hydrofoils, both commercial and naval.

Built for the U. S. Maritime Admin-

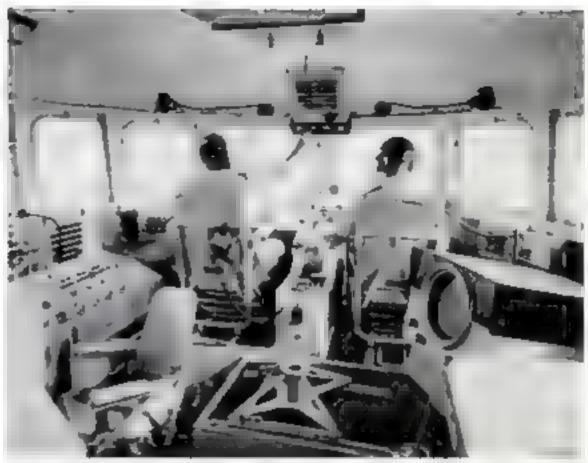


Mighty gas turbine in deckhouse of Denison, continuously delivering 14,000 hp., gives craft its speed. Adapting such aircraft-type engmes to propel hydrofoils is a major U. S. advance.

Hinged tail strut, shown retracted, has stern foil at its bottom. It also carries extensible rudder flaps (one on each side) and ship's 36-inch propeller, which can reach 2,870 r.p.m.



Sitting in water with its foils retracted after a speed run, the Denison heads for dock at a brisk 11 knots—propelled and also steered by water jets from two nozzles on underside of hull, near the stern.



Pilot and co-pilot man plane-type steering wheels in pilot house of Demson. Behind them are stations of engineer and navigator.

in 1963, on the world's first hydrofoil line over open ocean

istration by Grumman Aircraft Engineering Corp., the 60-knot, 90-ton Denison was launched last June at Oyster Bay, N. Y. Sea trials in the Sound and the Atlantic have since been readying her for service. Next year, by Marad's plans, paying customers will be able to ride the new speed queen of the seas.

Fitted to carry passengers and chartered to Grace Lines, the Denison is to go into high-speed service between Port Everglades, Fla., and the Bahama Islands. That will provide a practical test of the prediction that hydrofoil liners can offer a new and attractive kind of ocean travel, faster than steamships, thriftier than planes.

For taxiing: water jets. Your first glimpse of the Denison at her dock may make you wonder if she's in service. Her forward foils, retracted for docking, arch above her like a gull's wings. Clear out of water, too, is a tail strut bearing her stern foil—and her one and only propeller. Still in that deceptively help-less-looking state, the loaded Denison mysteriously glides away from the dock at a lively 11-knot clip. Water jets from two nozzles beneath her hull—powered by an auxiliary 1,050-hp. gas turbine and

a pump-propel her to open water, clear of harbor traffic.

Then her hydraulically operated foils clank down and lock in place. Her main 14,000-hp, gas turbine roars into action, her racing screw bites water—and the ship darts forward like a jet plane taking off. At 26 knots or thereabouts, she's up on her alloy-steel foils. These, exerting lift like a plane's wings, support her all-aluminum hull clear of the water and free of the frictional drag that limits a conventional ship's speed. Now, with her mighty turbine, and novel high-speed propeller, the Denison can leap to her phenomenal 60-plus knots.

In the pilot house. Acting as pilot and co-pilot, her captain and first officer sit side by side in the pilot house, each at an airplane-type steering wheel, with engineer and navigator just behind them. Turning the wheel extends either one of a pair of rudder flaps, hinged to opposite sides of the tail strut. At the beginning and end of a run, when foils are retracted and water jets propel the Denison, the same wheel deflects the jets for steering.

Another of the Denison's controls, and one of the most important, operates au-



Hydrofoil sub chaser High Point, launched last August, will look like this in operation. A fullfledged warship armed for combat, the 110-ton, 115-foot craft is expected to hit 40-50 knots.

tomatically: a system that keeps her on an even keel. Instantly sensing the beginning of pitching, rolling, or heaving, an autopilot forestalls it—by making continuous readjustments of movable liftcontrol flaps on the forward foils, and of the inclination of the whole stern foil. To this system, a radical departure from the simple fixed foils of calm-water hydrofoil craft, the Denison owes her seagoing ability.

Deliberately the Denison has been designed as a multipurpose "test vehicle," rather than specifically as a passenger ship. So her capacity of 60 passengers—for whom accommodations are to be installed after her sea trials—is much more limited than that of the hydrofoil passenger ships foreseen as her successors in a Stanford Research Institute study recently completed for Marad.

On the Florida-Bahamas run, one of several examples considered, this study envisions a daily trip each way by a

[Continued on page 180]

All-underwater foil of High Point has movable trailing flap, controlled by autopilot, to maintain even keel. Shaft through tapered pod will turn screws at each end, forward and aft of foil.



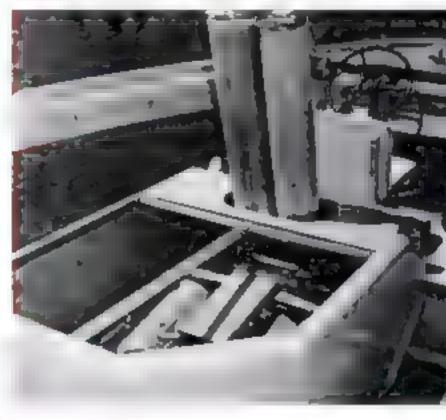


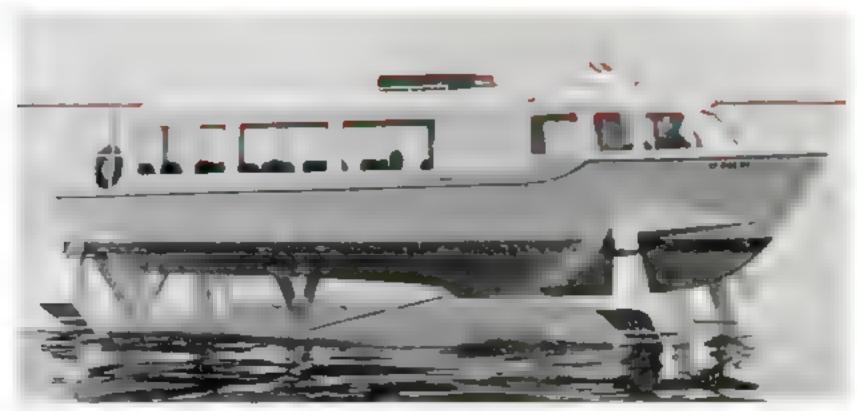
Out-of-water view shows Albatrosa' simple fixed foils. Planing step in hull aids quick takeoff, and craft becomes foilborne in a run of only 500 feet.

Riding a Hydrofoil... Sm-o-o-oth

By James Joseph

Six-cylinder 186-hp. diesel, behind pilot, drives propeller at stern. Photo was made before craft was fitted with aluminum-and-glass cabin for passengers.





Throttle open, Albatross flies on foils. It will carry 24 passengers, plus a crew of two.

A 34-FOOT made-in-the-U.S. commercial foilboat—a pygmy compared with the big Denison on the preceding pages—may give more Americans their first taste of travel by hydrofoil.

This 24-passenger, all-aluminum craft displaces six tons—in contrast to the Denison's 90. It's designed for offshore commuter service, and river and lake routes, instead of high-seas runs. Its foils are of the simple, fixed "surface-piercing" type.

A 180-hp., six-cylinder diesel engine propels it at 40 m.p h., its hull skimming 2% feet above the water. A conventional five-foot-high rudder, just behind the after foils, steers it. Within its enclosed cabin, passengers ride in six rows of airplane-type seats, arranged with two seats on each side of a center aisle

The first craft of this new U. S. type, named the Albatross, has been successfully tested in trial runs. It's expected to be put in service soon on a California coastal route, still to be selected at this writing.

Five Albatross-type craft are being produced initially by their designer and builder, Hydro-Capital Corp. of Newport Beach, Calif. Within a few more months the firm hopes to have 15 of the boats flying. It plans to franchise their operation to skippers in business for themselves, all over the country.

How will it feel to travel on one of these fast hydrofoil craft? To find out, I rode the Albatross on a trial spin from its Long Beach, Calif., dock.

"Lift off!" signaled the skipper—and we were flying. I cheked my stopwatch. Just 20 seconds under way, the Albatross had shaken the brine from her keel and risen on her winglike foils. Only the sudden jab of the wind gave an inkling that she was speeding at 36 m.ph.

Through two-foot chop the going was unbelievably smooth. I walked stem to stem without needing to grab for handholds. A bubble in a carpenter's level wouldn't have budged from its center mark.

Absent was the bone-rattling sledging a boatman expects at much past 20 m.p.h —and the vibration that racks a waterborne hull as it hangs between waves. You hear only the whistling wind, the cascade of water as the foils knife through it, and the throaty beat of the diesel

At full throttle the Albatross' pilot put her into tight 150-foot-radius turns. She heeled scarcely at all.

He throttled her down to 15 m.p.h., as he would at the conclusion of a commercial passenger-carrying run. Sedately her hull settled into the sea—the foils, now acting as outriggers, stabilizing the ride. The flight was ended.

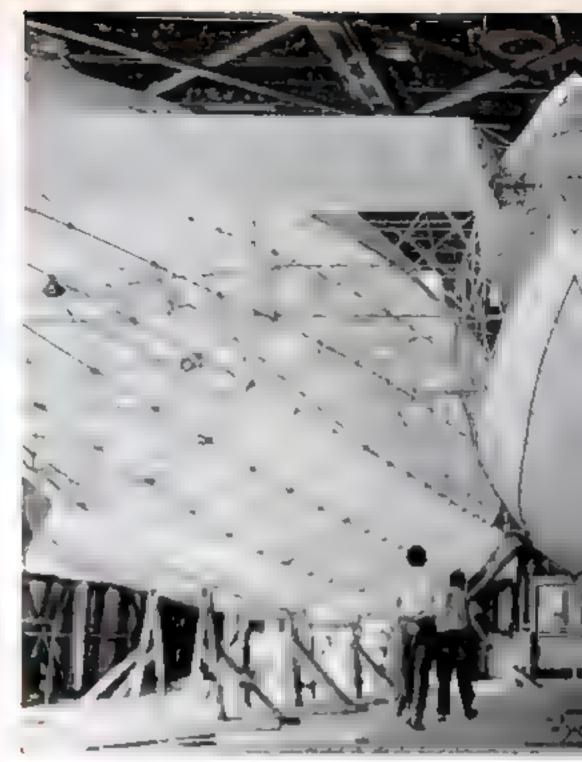


Short, Sad Saga of the Three-Blimp Aereon I

Dr. Solomon Andrews (shown in portrait above on a page reproduced from the January, 1932. Issue of Popular Science Cwas a man of wide interests and accompltshments. Aside from his activiinclical practice, he served as mayor of Perth Amboy, N Ja pat-ented many money-making he ventures and designed, built, and flew bls unique, fur-abend-of-thetimes triple-hulled Aereon 1 airslup. His objective was patriotic llying reconnaissance missions across Confederate lines to help shorten the Civil War

In Washington he ran into red tape, deays, and rebuffs, Then, in au elfort to create interest in his maneuverable flying machine 6c Hew the engineless three-bagger over New York City startling menwitten children and herses New York newspapers well and his air ship is the most wonderful and greatest invention of the age Reported the New York World "Navigation in the air is a fixed fact. The problem of cectories has

been solved But, with the Upul War about over and won Washington buremeracy was stirred not one bit Still Dr Andrews didn't give up He built his single-hall Access 11 and brosed the Aerial New gation Co, to set up in air-transport line between New York and Paradelphia. The bank where the compamy kept its funds failed. Dr. Andrews gave up.

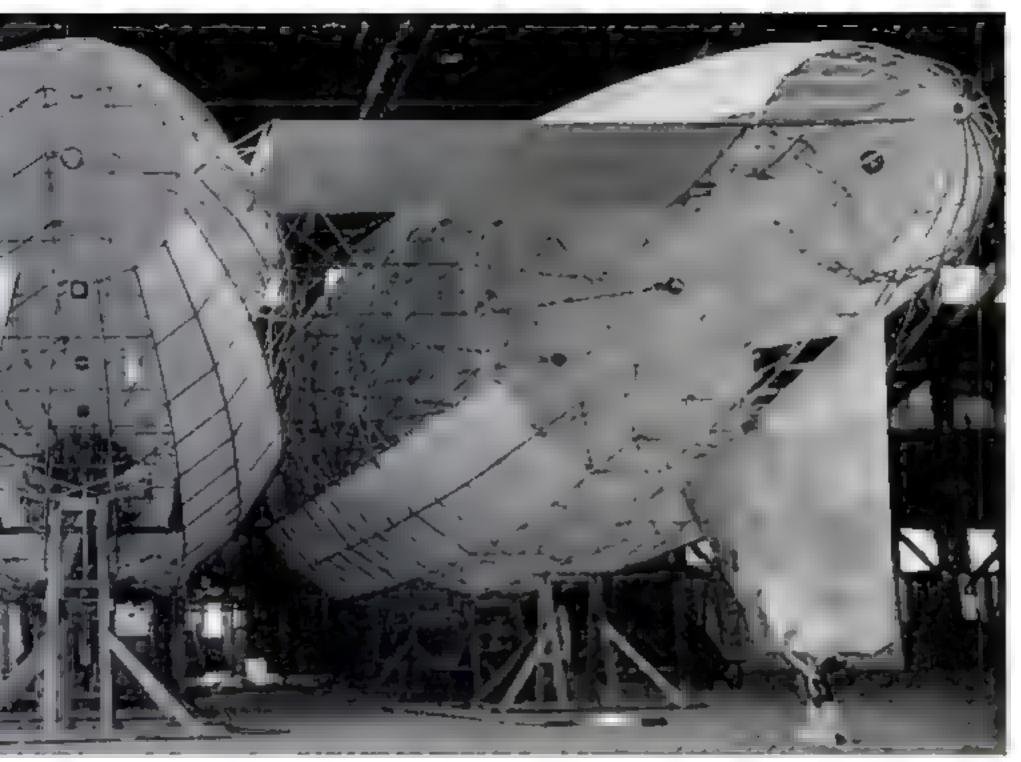


Triple-bagger is shown during construction at

Behold the Trigible!

Who said lighter-than-air craft are dead? Not us. But you've never seen a flying machine like this one unless you've been nosing through the files of Popular Science of 30 years ago, when we published an article on the big idea adapted by these two Navy veterans for their startling dirigible

By Herbert Q. Johansen



Mercer County Airport, Trenton, N.J. Main framework of ship is duralumin tubing.

chine I've ever seen was not in the Smithsonian Institution, but at Mercer County Airport, Trenton, N.J.—a brand-new, glossy-white "trigible" being readied for its first trial flights. Called the Aereon III, it quite likely will have flown by the time you read this.

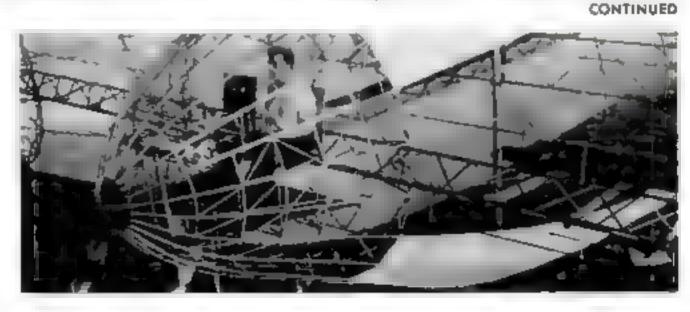
"Why three hulls?" I asked the Rev. Monroe Drew Jr., a 45-year-old Navy Reserve chaplain, Presbyterian minister in Trenton—and the mainspring behind

this bold venture to bring back the dirigible.

"To give better aerodynamic lift than the conventional single hull," answered Mr. Drew. "Dr. Solomon Andrews demonstrated the aerial efficiency of a triple-hull airship 100 years ago when he nacigated at speeds of more than 100 miles an hour—upwind, downwind, crosswind—without an engine."

"Who was Dr. Andrews?" I asked.
"The designer and builder of Aereon

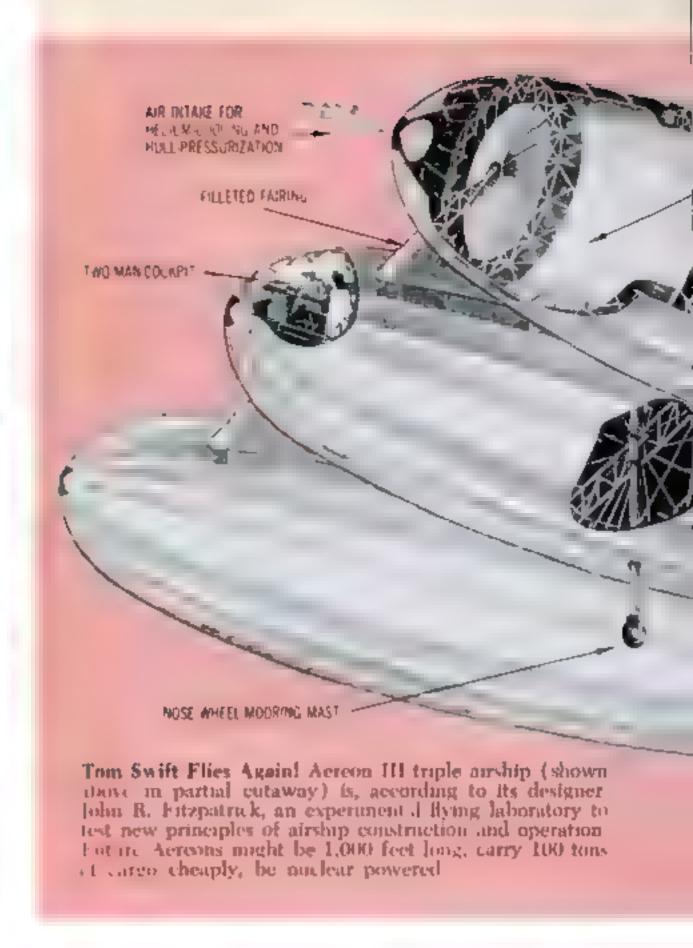
Two-man cockpit is in the nose of the middle hull. At tip of nose is intake for a cool-air blower. Shown in cockpit is John R. Fitz-patrick, the project's chief engineer.







Nose landing wheel is also a built-in mooring mast. Swivel plate just above wheel is for treing the airship down on the ground. The telescoping strut extends up into the center hull where the stress is distributed among frame members.

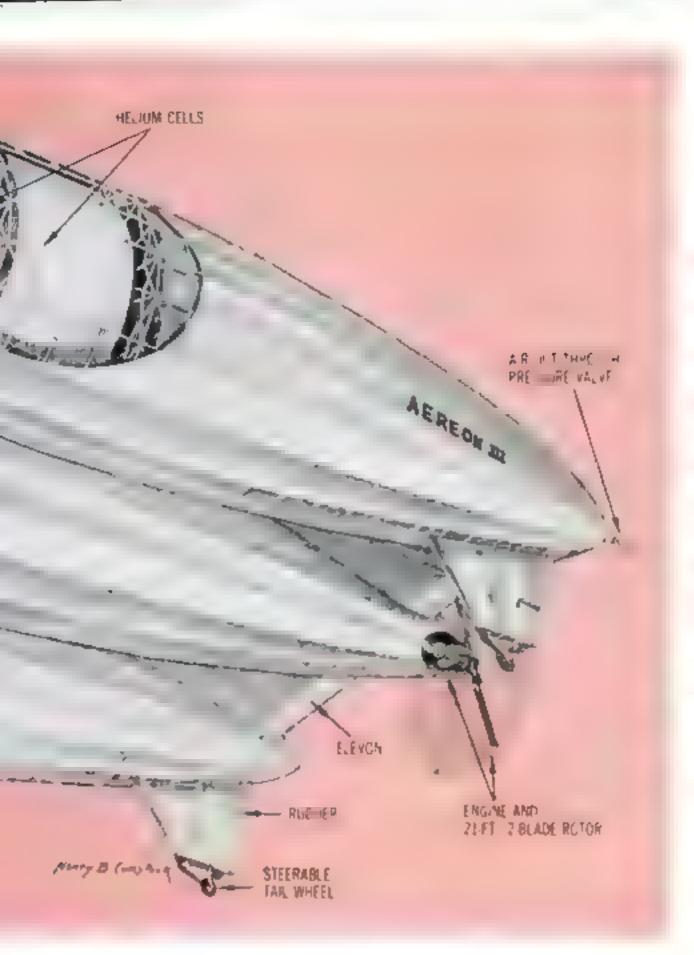


I, back in 1863," said Mr. Drew. Then he explained that his own interest in airships dated back several years to one afternoon when his youngest son, Malcolm, came home from his sixth-grade classes loaded with questions about lighter-than-air ships. The father, not knowing the answers, decided to find out. During his research he came across an article in the January, 1932, issue of Popular Science, "He Flew Before the Wrights Were Born." It was a detailed account of Dr. Andrews' amazing aerial-navigation feats with his trigible during the Civil War.

The three-hulled Aereon I fascinated Drew, and led to the forming of a company to build Aereon III. (Dr. Andrews built a single-hulled Aereon II, but it was abandoned for lack of interest and funds.)

"Gravity power." Although the newborn Aereon has a small rear-mounted turboprop engine, it can achieve forward speed by "gravity power" alone the only means of propulsion Dr. Andrews had, except when he was flying with the wind.

How does this "built-in tailwind" work? Very simply, explained the designer of the Aereon III and the company's chief engineer, John R. Fitzpatrick, a 40-year-old retired Navy lieutenant commander and aeronautical engineer. He describes the craft as "a large symmetric airfoil exerting enormous lifting force in





Important innovation is the use t i new superstrength plastic film Tedlar, sections of which at slow there and pressure. topics for the flat in a page nale white-pignout domain terral is used both for the outer hull skin and the helium cells

flight." As the gas cells within the hulls are filled with helium, making the ship lighter than air, it rises like a balloon. Then, by using control surfaces to change its angle of attack, tilting it about five degrees nose up, it goes not only up but forward, gaining speed for free. On airship is made heavier, and the nose valved to make the Aereon I heavier. tilted downward for a forward descent.

By repeating this up-and-down maneuver, Dr. Andrews, according to newspaper reports of 1863, flew at more than 120 miles an hour without benefit of wind or engine. His range was limited, however, because he could carry only so much ballast to dump for lightening, reaching altitude, say 10,000 feet, the and just so much hydrogen gas could be

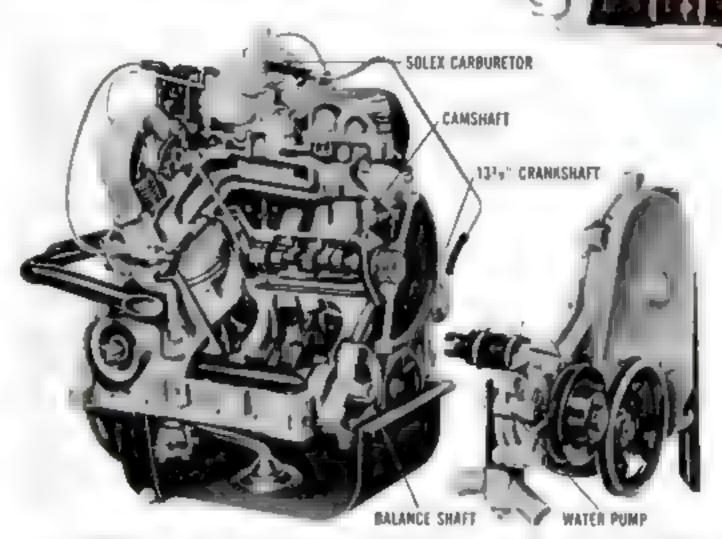
[Continued on page 202]

Partially inflated belium cells are tested for tightness of taped seams. In the background is one of the 83foot-long Aereon III hulls with its outer skin nearly completed. A onemen air space separates that outer skin from an inner nylon skin.



The Car That Ford Wouldn't Make in America

The Cardinal, most radical production car ever designed in this country, is coming off the assembly line in Germany



High position of the camshaft permits use of short pushrods. Weighted balance shaft alongside the crankshaft; contra-rotated at crankshaft speed. cancels out inherent imbalance of a V-4. Intake passages running from single-throat Solex carb are of equal length, giving even distribution of fuel to all cylinders. Bore and stroke are 3 15 by 2.32 inches.

The Cardinal, miscarried in this country last spring. As the project advanced, it became obvious that the car couldn't compete in price with Volkswagen. Furthermore, the future of small cars in the U.S. was considered bleak

(except for Volkswagen, which keeps doing better each year). At the very last moment, Ford decided to hold off.

But the Cardinal is getting another chance in Europe. It's being made in Cologne, Germany, as the Taunus 12M.

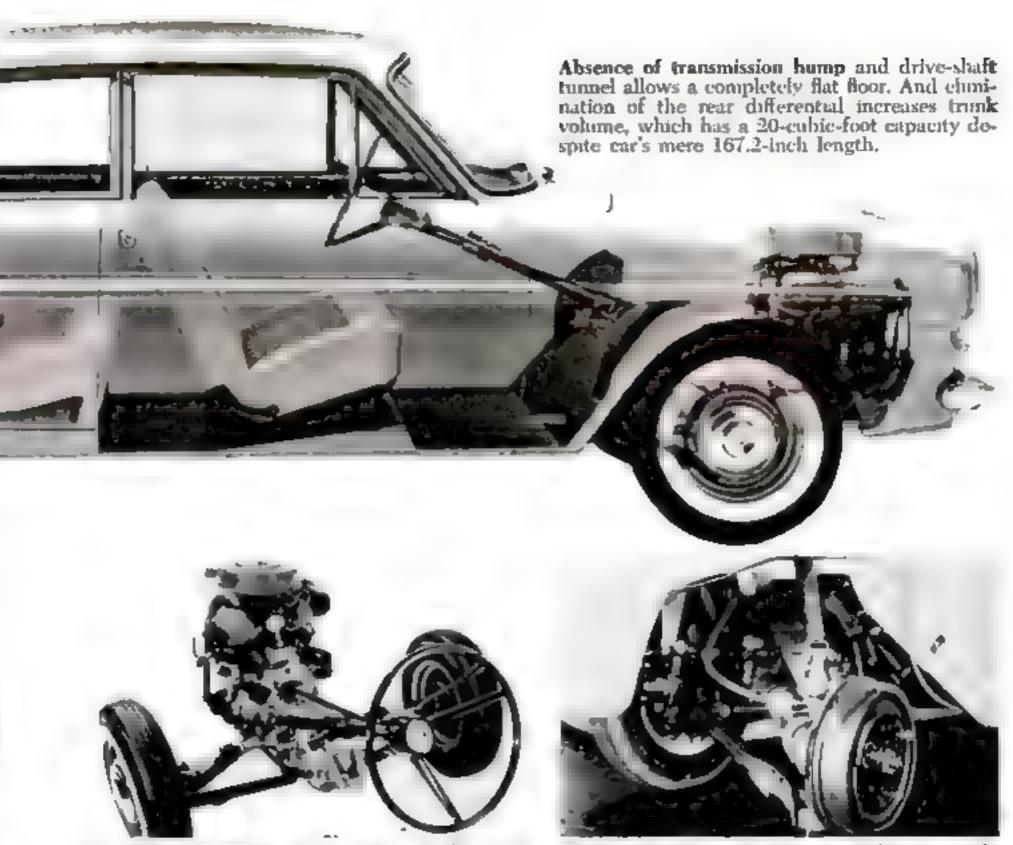
As PS predicted, it has a V-4 engine

Here's how the body styling compares with sketches in PS six months ago



64 POPULAR SCIENCE NOVEMBER 1942

For a look at a car that



Engine and clutch perch ahead of the front axle, in unit with the four-speed fully synchronized transaxle. Accessibility is excellent.

Single eight-leaf spring is mounted transversely in front. Leaves are a hefty three inches wide. Drum brakes are used all around.

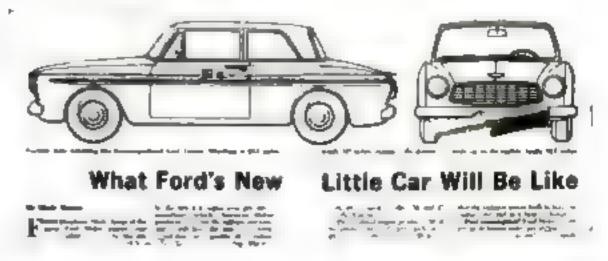
and front-wheel drive. The tiny 60-degree-V power plant displaces 72.2 inches and puts out 50 hp. at 5,000 r.p.m.

An unusual feature of the car is its cooling-system plumbing. No coolant enters the radiator until its temperature reaches 176 degrees. This speeds up en-

gine warmup. Also, there's no powerrobbing engine fan. When the temperature climbs too high, a thermo-sensitive switch starts an electric blower that sucks fresh air through the radiator core.

The car has a unitized body on a 99.5-inch wheelbase.—David Scott.

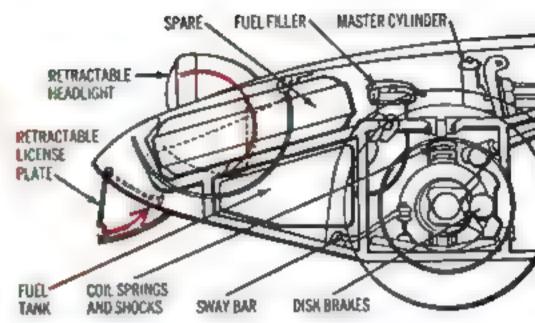
Our story last May predicting what the Cardinal would be like included the drawings at right by one of our artists. They proved to be remarkably accurate; the shapes of the roof line, grille, wheel cutouts, and side sculpturing were near perfect. One difference: Taunus lettering replaces the Cardinal emblem.

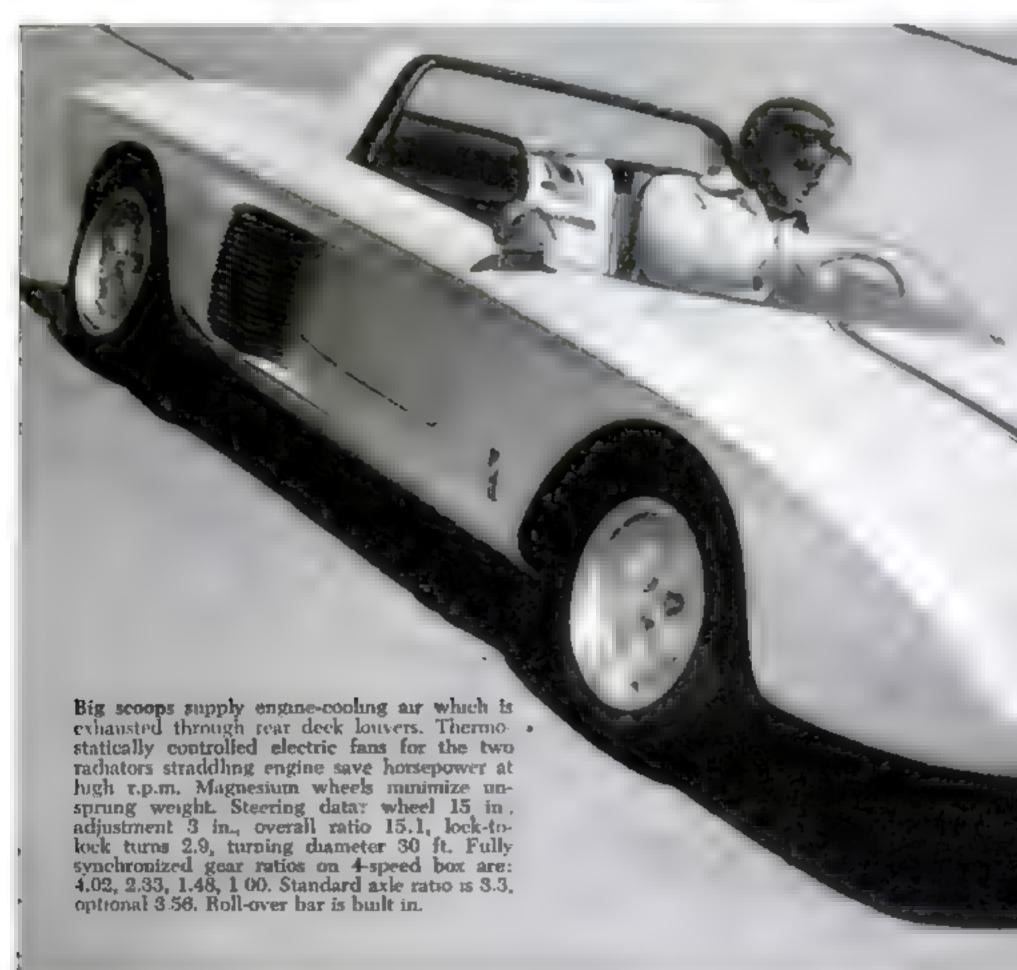


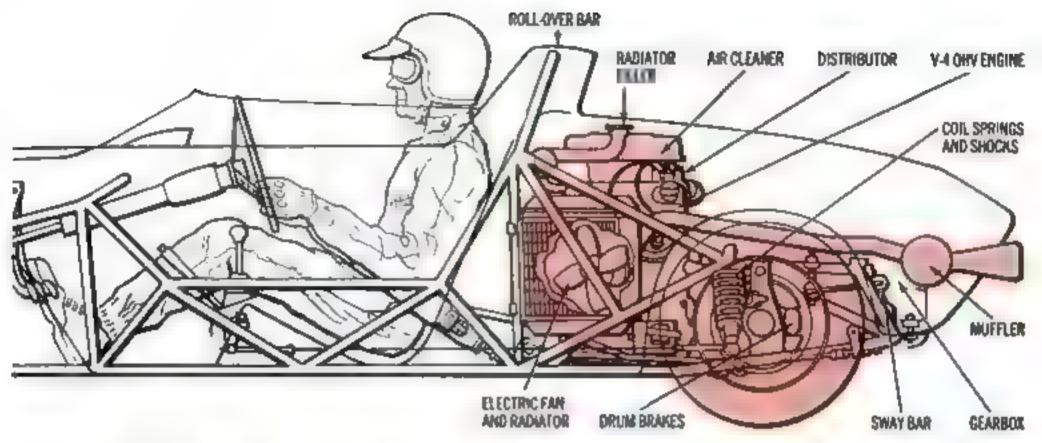
A Ford sports car? Could be

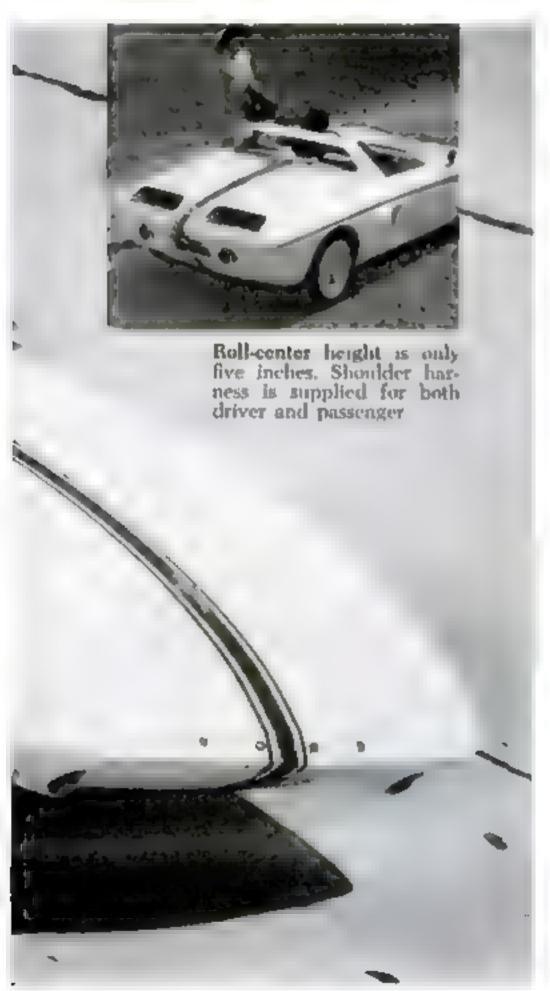
The Mustang —a V-4 for Fun

Mustang's wheelbase is 90 inches, length 154.2, displacement 1,500 c.c., horsepower 106 at 6,-500 r.p.m., torque 96 lb.-ft at 5.200. Frame is tubular, the skin aluminum Manual flip-over headlamps and foldaway front beense plate reduce air drag. Spare tire is up front



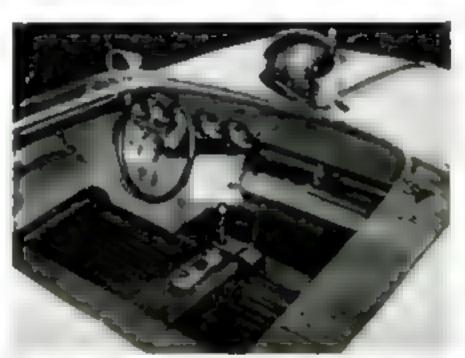






HE splashiest car to show up—for exhibition runs only—at a Sports Car Club of America road race at Watkins Glen, N. Y., last month was, astonishingly, Ford-built. The Mustang is powered by a rear-positioned, 60-degree V-4 engine originally intended for the defunct front-drive Cardinal, While admitting only that it is experimental, Ford also is coy about its future. Best guess: commercial production late in 1963. Price: under \$3,000—and well under.

The weight-to-power ratio is expected to be about 10 or 12 pounds per horse-power. For good weight distribution, the spare, battery, and gas tank are in front, the engine is ahead of the rear axle, and the transmission is above it. Stabilizers control road stiffness.

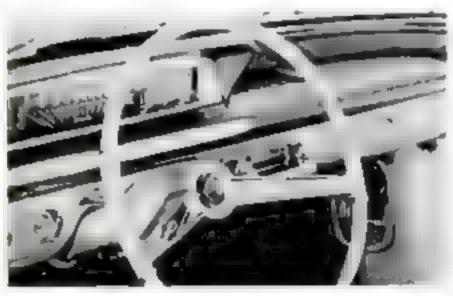


Instruments include speedometer, tach, ammeter, fuel, and oil and water temperature gauges. Brake, clutch, and accelerator pedals are adjustable as a unit with range of four inches.



'Big' Rambler for '63 Is Littler

WHEN the big Ramblers ("big" beside the small Rambler American) came out last month, they were littler than in '62-by a mite over an inch of length. But both cars, the Classic and



Control knobs are recessed for safety. A panel light warns if a turn signal burns out.

Olds F-85 Is Bigger

THE change that leaps to the eye in Oldsmobile's compact F-85 for 1963 is in the styling. There's 4.2 inches more rear overhang, for a new overall length of 192.4 inches.

Mechanical innovations are more sub-



tle. Front and rear suspensions have improved damping for less noise and a softer ride. Self-adjusting brakes are standard, as are an alternator and a huskier battery with a three-year warranty. The starting motor develops more



the Ambassador, had an impressive four inches more in wheelbase—112 inches. They also were lower by almost three inches. The snipped-off height was achieved with step-down floors. While

hip room in the front seat and head room in front and rear were up, front and rear leg room and rear hip room were down. Both cars offered twin sticks with over-drive [PS, Oct., p. 80].



torque for easier fire-ups in cold weather.

Other improvements include a longerlasting aluminized exhaust system, transistorized radio, and a smaller steering wheel for more leg room and easier handling. Interesting in air-conditioned F-85s is a cross-flow radiator with a thermostatically controlled fan clutch

The seat-belt mounting plates have been relocated for improved appearance. They also make rear entry easier.

"I'd like to see them make..."

20th-century beds, like baby menhators, with controls for heating in which connig in summer. No daily to be known just cover the thing in the dwime with a spread.—II. J. McGraw, Newark, N.J.



Pull-string openers on frozen-food packages. One yank of the string would tear the paper and open the box so you could slide out the rigid block.—L. M. Gardener, N1C.



Arrows on left-hand nuts to point direction when removing them and prevent stripping threads and wasting time. Think of the tempers they'd save!—Richard Socidner, Plain, Wis.



Wire-bristled whirling brushes for cleaning whitewall tires. Put cleaning solvent in the special compartment and whirl away - no cloow grease.—A. C. Orenstein, Philadelphia, Pa.



Flexible rainspouting for forming downspouts around complex roof overhangs. Why not make tubing something like that used on a gooseneek lamp?—Ken Clayton, Columbus, Ohto.

Everyone has his own pet idea of a gadget that he would like to see in general use. What a nouri? We will pay \$5 for each one published. Please use Government postcards

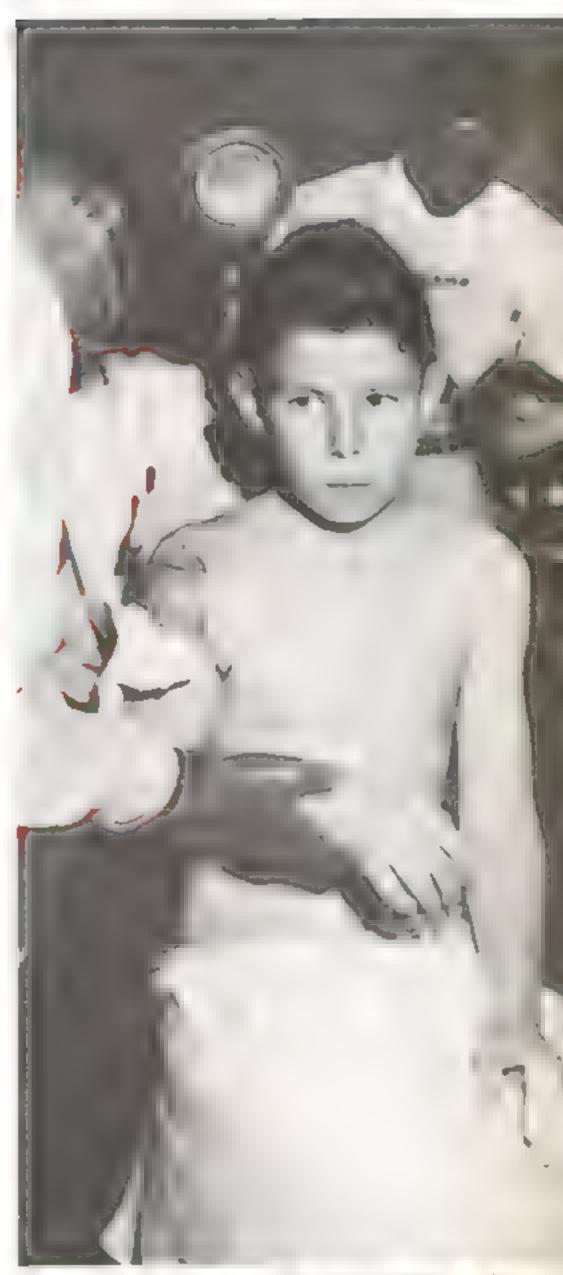
only. Send to ILTS Editor, Popular Science, 355 Lexington Ave. NIC 17 Write vour name and address clearly Contributions ranged by acknowledged or returned

DOUBLE-LENGTH FEATURE: THE STORY OF A SURGICAL TRIUMPH

The Boy Who Lost His Arm —and Got It Back

By Joaπ Steen

Outside the walls of Boston's famed Massachusetts General Hospital last May 23, the day was calm and mild. Inside, it was anything but. By two in the afternoon the emergency ward was booking a dozen patients an hour. Many were serious cases. There was a pneumonia victim and there were



Skin grafts and stitches are the violety, were of the dramatic restoration. I becrett knowledge in a similar

CONTINUED

Minutes after the accident the still-conscious boy was rushed

heart attacks. There was an aneurysm—a dangerously dilated artery. Everett Knowles III, a 12-year-old boy, came in at 2:40. His case was more than just serious. It was to make medical history.

Less than an hour later the boy lay on an operating table while a dozen specialists, nurses, and attendants prepared for extraordinary surgery. The boy's arm had been cut off—completely—just below the shoulder joint. They were going to sew it back on.

This was an unprecedented operation. Why did the doctors decide to try it? How did they go about it? What prospects are there for the boy? For surgery like this?

The answers are dramatic. The story of this historic operation is one of courage, skill, teamwork—and hick. There are no villains. There are many heroes. Each forged a link in as miraculous a chain of events as has ever shaped a man's—or a boy's—fate.

The story begins in Somerville, a drab industrial suburb of Boston, Somerville is a hilly place, crowded with the shops and factories where many of her 95,000 inhabitants work. Its side streets intersect major routes into downtown Boston. Its steep hills are sliced by the freight lines of the Boston and Maine Railroad.

When school lets out at two, many Somerville kids make for the tracks on their way home. They run down the grassy slopes and jump down the six-foot embankment. The more daring dash across the tracks when they see a train coming and grab rides on passing boxcars.

The police shoo the kids away. They come back.

Everett Knowles was no exception. A bright, freckle-faced Little League pitcher, he wanted to try his luck, too. What he didn't know was that the overpass abutments hug the tracks tightly. A rider who hopped the outside of a freight would be wiped off as the train went under a bridge.

This is what happened. But exactly how Everett's arm was cut off no one knows. From the "avulsed" (torn) look, doctors think the arm was sheared off by the abutment. Had it been run over by one of the train's wheels it would probably have been crushed beyond repair.

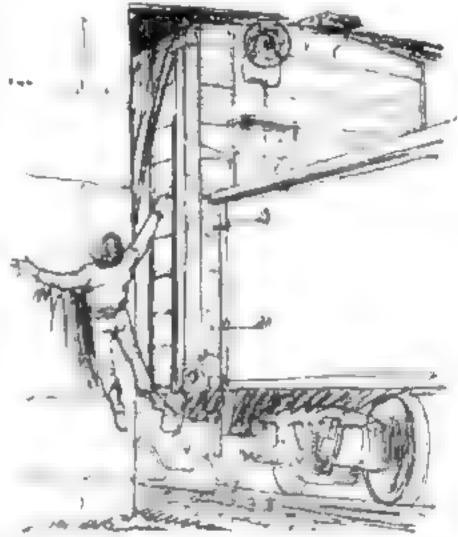
Everett's own memory washed blank. He recalls only picking himself up and starting

to climb the slope. Moments later, he came out on Medford Street, at the foot of a hill. The time was close to 2:30.

AT THE top of the Medford Street hill is the Handy Card and Paper Company. Norman Woodside, the 42-year-old curly-haired, pipe-smoking foreman of the plant, picks up the story from there:

"It was a funny thing, but we had run out of paper that afternoon. So a couple of us from the press room were helping the shipping boys load a truck. That's why the doors were open.

'The kid came walkm' up the street. I heard him sobbin'—not cryin' out or anything—so I asked him what happened. He said a car hit him. I guess he was afraid to say he'd been hoppin' freights.



Nobody knows exactly how the arm was cut off. Doctors think it was sheared off by the stone abutment.

"He had his hand turned upside down, so I figured he had a broken arm. He was wearing a sports jacket and a long-sleeved shirt—regular school clothes—and he was pretty dusty. I asked him where he was goin' and he said 'home.' So I called to one of the fellas to grab him."

"I ran down to the office to call the ambulance," Woodside went on. "I passed

to the hospital. The severed arm lay inside his shirt sleeve

Alice on the way and told her there was a boy upstairs with a badly broken arm."

"Alice" is Mrs. Alice Chmielewski, a clerk in the Handy Company. She is a neat, slim, alert-looking woman who has always been squeamish about the sight of blood. (Some of the press-room boys tease her by dipping their hands in red ink.) The first thing she thought was that the boy was her own son. She ran up.

Everett was lying on the loading platform. "You couldn't recognize the color of his shirt," Mrs. Chmielewski said, "it was so covered with blood. His stomach, too, where he'd been holding his arm with his left hand, That

hand was all crushed and bloody "

Mrs. Chmielewski grabbed what clean rags she could find, knelt down by the boy, and put his head in her lap. She turned his head away from the strangely twisted arm so he couldn't see it. When he asked about it, she said it was all right

First she thought she would apply a tourniquet. Then she found the gap within the sleeve. She was horrified. The boy's arm wasn't broken. It was completely off

IMMEDIATELY Mrs. Chmiclewski did the only thing she could think of, It turned out to be the perfect thing. She pressed rags to the wound to try to stop the bleeding. Had she applied a tourniquet to the shoulder, almost certainly vital tissue would have been destroyed. The operation would not have been possible.

Meanwhile Woodside had dialed the emergency number that rings in Police Headquarters as well as in the Fire-Ambu-

lance Station.

Car Three of the Somerville police was cruising nearby. Sgt. Donald MacElree and Patrolman William Heafey arrived within a minute. The time was 2:32.

Three minutes later the ambulance—actually a retired police paddy wagon—pulled up, its siren moaning. It was manned by Firemen Edward Cutting and Robert Loan of Engine Three, Mrs. Chimelewski, who had been talking to the boy all the while ("I felt if I kept talking to him, he wouldn't die"), rode to the hospital with them. The odd-looking ambulance drew up to the emergency-ward entrance at 2:39.

The emergency ward was waiting for them. After Norman Woodside called the



police he had had the forethought to phone the hospital. He didn't know then that the arm had been amputated. He said he thought it was a compound fracture

Dr. L. Henry Edminds Jr. was the assistant resident in surgery in charge that day, and thus in command of the medical and surgical residents and the one "H.M.S IV"—a fourth-year Harvard Medical School student—who make up the 12-hour day shift of doctors.

THE wheeled bed carrying Everett Knowles across the corndor into the ward didn't stop at the desk for paperwork. It rolled down the red-tiled hallway and directly into an emergency operating room. A half-dozen staff people were already gathered there.

"There was nothing unusual about this," says Ferdinand Strauss, a tall, spectacled, quiet-voiced man who is the administrator of the emergency ward. "It's routine whenever we get advance warning that a serious

case is coming in."

Everything happened so fast now that neither Dr. Edmunds, nor Dr. S. Bert Litwin, his assistant, remembers exactly when they realized that they were faced with a complete amputation and not a compound fracture. Incredibly, the sleeve still enclosed the severed limb.

What the doctors do recall, when a nurse cut away the sleeve, was their reaction. The moment they saw the naked limb they were seized—simultaneously—with the wild

"It looked so perfectly good, so alive," the emergency doctors



surmise that the arm could be re-attached.

"You'd have thought the same thing if you had been there," Dr. Edmunds said. "It looked so perfectly good—so alive. The only thing wrong was that it had been cut off."

The young doctors knew they had a rare situation. Here was a 12-year-old boy in good health and reasonably calm. He had been brought to the hospital within minntes of the accident. His right arm was off, and they could see a portion of bone sticking out. The fingers of his other hand were crushed, but there seemed no other compheations. If such an accident had to happen, this was almost an ideal set of circumstances. But they would need expert help. They began by calling Dr. John B. Herrmann, Edmunds' immediate superior. He in turn called his next-in-command, Dr. Ronald A. Malt, the quick-thinking young surgeon who was to be the crucial decisionmaker that historic afternoon.

In the meantime there was no waiting around. The boy was given a general examination. A blood sample was taken and typed. The boy was prepared for a transfusion. He had lost about two pints of blood

With a severed artery the situation could have been much worse, but again fate was kind. The brachial artery, pumping blood

from the heart, had sealed itself off. Two forces were at work here: evolution and youth. In the course of man's development the complex networks of muscles and nerves have built up defenses against injury. Muscles—in this case the muscles in the artery wall—contract. Nerves, also in the artery wall, trigger spasms to reinforce the effect. Both of these responses are strongest in young people.

"And all this while," remarks Strauss, "the boy remained fully conscious. He was completely coherent and understanding. You might almost say he was at ease."

Nevertheless at 3:02 the entries in the emergency ward's logbook changed from blue ink (not serious) to red (critical). The boy had been put on the Danger List,

Dr. Malt arrived now, and Dr. John Head, assistant staff surgeon. Word had begun to spread throughout the hospital. Before the day was over, everyone from busboys in the basement cafeteria to orderlies on the isolation floor at the top of the White Building would wonder, worry, and pray that the operation would be a success.

But would there be an operation? At five minutes past three no one could say.

"The first consideration was that the boy survive and become a useful member of society," Dr. Malt said. "If we were to put

thought. But the arm had been cut off. Why not put it back?

back an arm and the boy died as a result, or if, later, the arm had to be amputated, no good purpose would be served."

The critical first step was to see if the veins and arteries in the severed arm were open and undamaged. If they were blocked or severely injured, there could be no hope

of re-establishing circulation.

"So," continued Dr. Malt, "we alerted the operating floor to the unusual circumstance that somebody would be coming upstairs with an amputated arm. We said we would like a full operating room set up to perform certain tests."

Simultaneously the same room was to be prepared for a full-scale operation, if

the decision was to go ahead.

DR. HERRMANN carried the arm to the elevator and rode the two flights up to the operating floor in the White Building. The arm, wrapped in cloths and shrouded by a sheet, lay in a basin filled with crushed ice. (The chilling was to slow down the tissue's need for oxygen. Dr. Malt said later that if chilling had been maintained, it might theoretically have been possible to delay surgery as much as 24 hours, Without this "hypothermia," serious muscle deterioration would have set in within four hours, followed by rigor mortis,)

When Dr. Herrmann reached Operating Room 5 he found Mrs. Judith Moberly waiting for him. The pretty 24-year-old scrub nurse had been setting up instruments for another operation when the call came from

the emergency ward.

After Dr. Herrmann had scrubbed up and donned a surgical gown, the two careIt was cold and blue-looking. First they bathed it. Then Mrs. Moberly prepared the solution Dr. Herrmann wanted to flush through the artery. In a metal pitcher she mixed saline solution with heparin—to prevent blood from clotting—and several anti-biotics. Then, very gently, Dr. Herrmann syringed this into the artery. They hoped the solution would flow down the main artery through its branches in the lower arm and return through the venous system. It worked. They got a partial return. They were elated.

Next came X-rays. A technician stood by ready to take the pictures as soon as a second solution of radio-opaque dye was injected in the arm. This would make the blood vessels show up as dark lines.

Down on the first floor the doctors and nurses were readying Everett to leave the emergency ward. His father had arrived and given the ether permit needed in sur-

gery on children.

Mrs. Chmielewski, waiting in the lobby, looked down at her blood-stained dress. She wondered how she would get home. She saw one of the firemen-ambulance drivers and asked for a lift.

Now Everett was brought up to a small anesthesia room across the hall from O R. 5. There Dr. Joan Flacke with the consultation of Dr. David Seigne. Dr. George Battit, and Dr. Henrik Bendixen prepared the boy for anesthesia

The group of specialists mobilized in Everett's behalf was growing. It would continue to grow. Dr. Bradford Cannon, specialist in plastic surgery, would be called

The Massachusetts
General Hospital team
that saved the arm
included (left to
right) Drs. Ronald
A. Malt, John Head,
Lucian Leape Jr.,
Robert S. Shaw,
Henrik Bendixen,
Joan Flacke, David
Mitchell, Bradford
Cannon, John B.
Herrmann and L.
Henry Edmunds Jr.





Orthopic Sustee and Lucin Lege Jr., an assist at research surgeon Other contern detted by the Josephils special light gracine contacts and form on Lother treatservices.

Some would take in a tive part in the operation tiel. Others would witch from the glassed in callery dieve the carrating form, keeping in touch via the intercommit

At five mentes past four Dr. Malt decided to try to real past the arm He teld Dr. Hake to begin an esthesia. He went over the X-acs with Dr. Herminia. The veris a danter supper and clear down to the mogetips. Then he phoned Dr. Robert S. Show a specialist in bloomvessel surgery. He would add one more to the group worting in Operating Book 5.

Operating Boom 5 is a general stage to room, roughly 20 feet square. It has given thed walls and a powerful everband light Several movable lights and introvenous poles stand in the floor Bull time the wills of the moral include the moral include the moral include the will be included as shelves. A resister is and a nest of outlets for AC and DC. for oxygen and X resistingment.

The doors on or will lead into an instructive stocking autoclave, and to a semb room shared with Openiting Room 6. It was there may hours later, that the surgery or Everett's left hand was done.

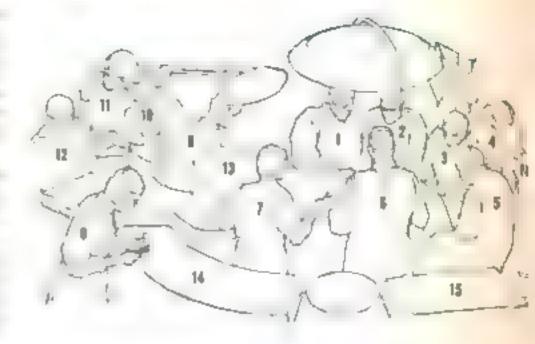
A door on an all cent wall opens into the corrie roleress from the anestress a prep room where Dr. Hacke was working. A few

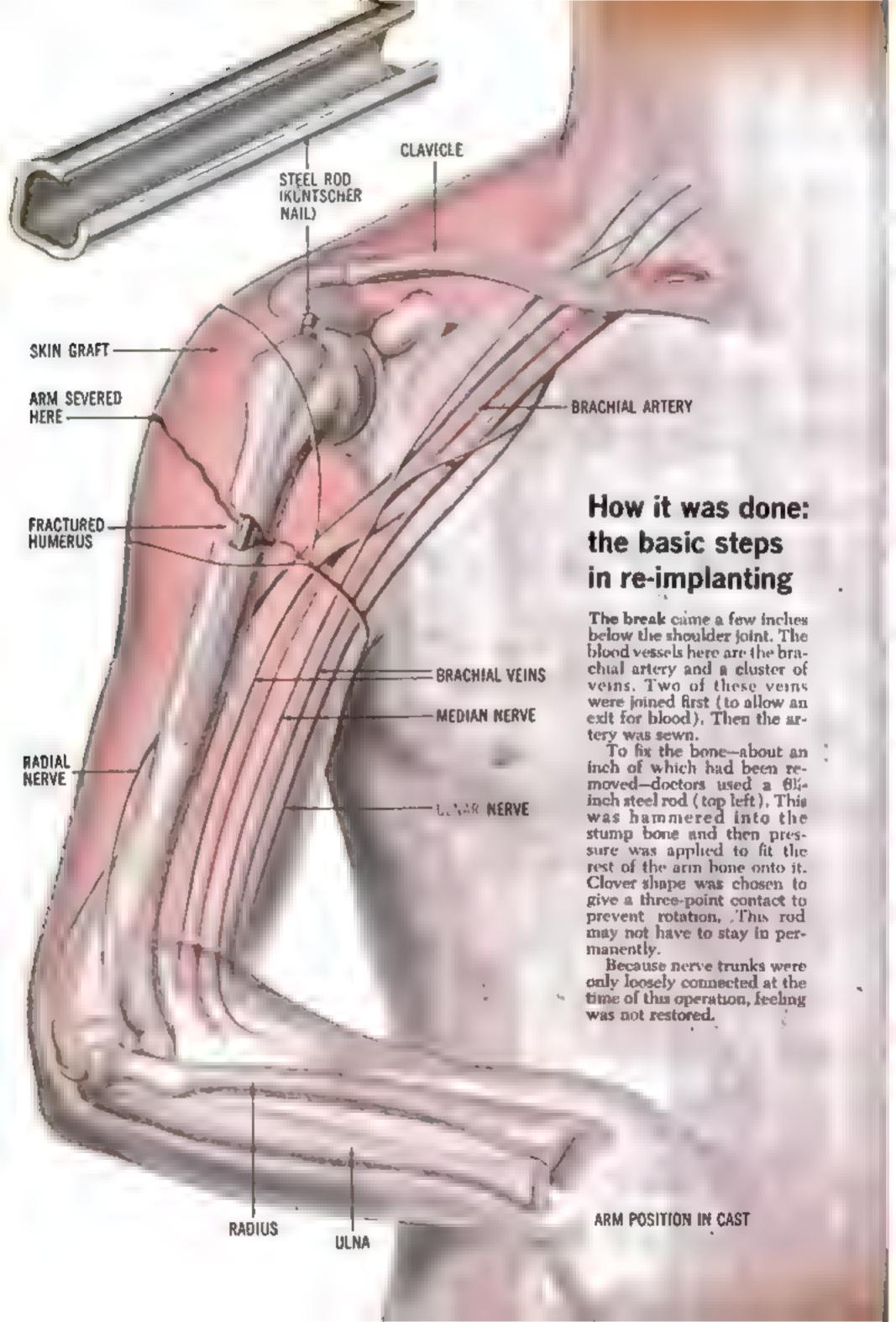


They watched a dead arm turn pink again

Operating Room 5 was the section that we have drained a restore the fine chirst call a chirst call chirst call a chirst call chirst call a chirst call chirst ch

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moments after Dr. Malt's decision, Everett was wheeled across this hallway, swathed in surgical wrappings from head to toe. The operation was about to begin.

NOW the room was alive with people: masked, capped, gloved, and gowned, some in pale blue, some in green. On their feet they were conductive shoes—grounded by a strip across the bottom to prevent a static charge from triggering an explosive reaction with the anesthetic gases.

Dr. Malt took his position toward the head of the operating table with Dr. Shaw by his side. Across stood Dr. Herrmann.

Dr. Flacke and her associates sat forward of the table. For the next eight hours they would maintain intent, uninterrupted watch over the unconscious boy. They would check his blood pressure, pulse rate, temperature, and depth of anesthesia. They would watch the slow inflation and collapse of the black rebreathing bag that showed his respiration rate. Regularly they would check the gauges and filters on the anesthesia equipment. Regularly, too, they would call out reports to the surgeons concentrating in another world a few feet away.

Angled off the foot of the operating table were Nurse Moberly and her instrument tables. One was a six-foot curving surface of glittering steel tools set out on blue sterile drapings. These were the general surgical instruments. Next to this table was a smaller one filled with special orthopedic equipment—mallets, hacksaws, drills, and hammers—a complete, but sterile, workshop, There was also a complete set of vascular and skin-grafting instruments.

Mrs. Moberly's job is to hand over scalpels, hemostats, sutures, forceps, clamps whatever is requested by a surgeon. She had never gotten a chance to leave O R. 5 after Dr. Herrmann had arrived. She recalls with a smile that "somehow they knew I would need orthopedic equipment—and it appeared."

The operating table and the circle of doctors and nurses around it constitute the "sterile" part of the room. Everything and everyone outside this circle is "dirty"—not germfree. Here is where the orderlies and attendants work. They pick up soiled equipment. They put the blood-sonked sponges on racks, so they can be speedily counted. They alter lights, check equipment, bring in more supplies. They can in fact do al-

most anything except touch the people or objects in the inner circle. They are the prop men and stagehands who never get to appear on stage.

THE first crucial step in the operation to re-implant Everett Knowles' arm was to sew the veins and artery back together to restore circulation. The veins are the brachial veins, a group that encircle the artery. Dr. Shaw supervised this part of the operation. It is a job that takes enormous patience and skill.

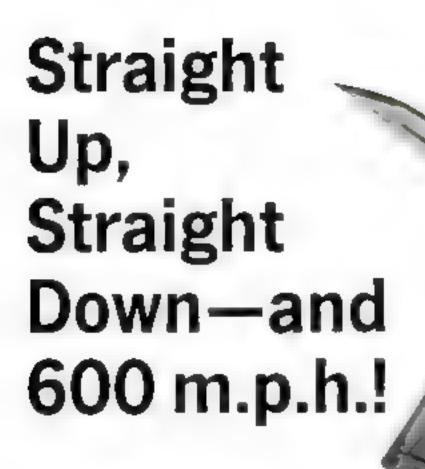
One problem is the size of the stitches. To meet the tiny dimensions of small vessels and the stresses and strains put upon them, many fine sutures must be taken.

Another problem is elasticity. While blood-vessel walls will stretch a little, doctors prefer to link the ends of severed veins with a tubular insert if a large gap exists. The insert can be a graft of tissue from another part of the body, or a dacron sheath. Doctors generally prefer grafts. "A piece of meat is better than a piece of cloth." Dr. Shaw comments

[Continued on page 186]



His arm in a cast, Everett was wheeled out of the hospital by his parents just three weeks after he came in.



NEXT summer should see the first flight of an extraordinary new Army plane—a little two-burner jet that can take off or land vertically and yet spurt ahead at more than

600 m.p.h.

Two five-foot counter-rotating fans flush-mounted in the wings, and one smaller fan in the nose, supply the thrust that lifts the VZ-11 straight up like an elevator. The fans are driven by tip turbines spun by the exhaust from the plane's twin JS5 turbojets. When the plane is high enough to clear obstacles—about 50 feet—the pilot tilts louvers under the wing fans to the rear to give the plane a forward push. At 120 knots the pilot cuts out the wing-fan system, and the hot gases, no longer diverted, stream out the tail-pipes. The plane darts off just like a normal jet. To get down to earth the pilot reverses the procedure.

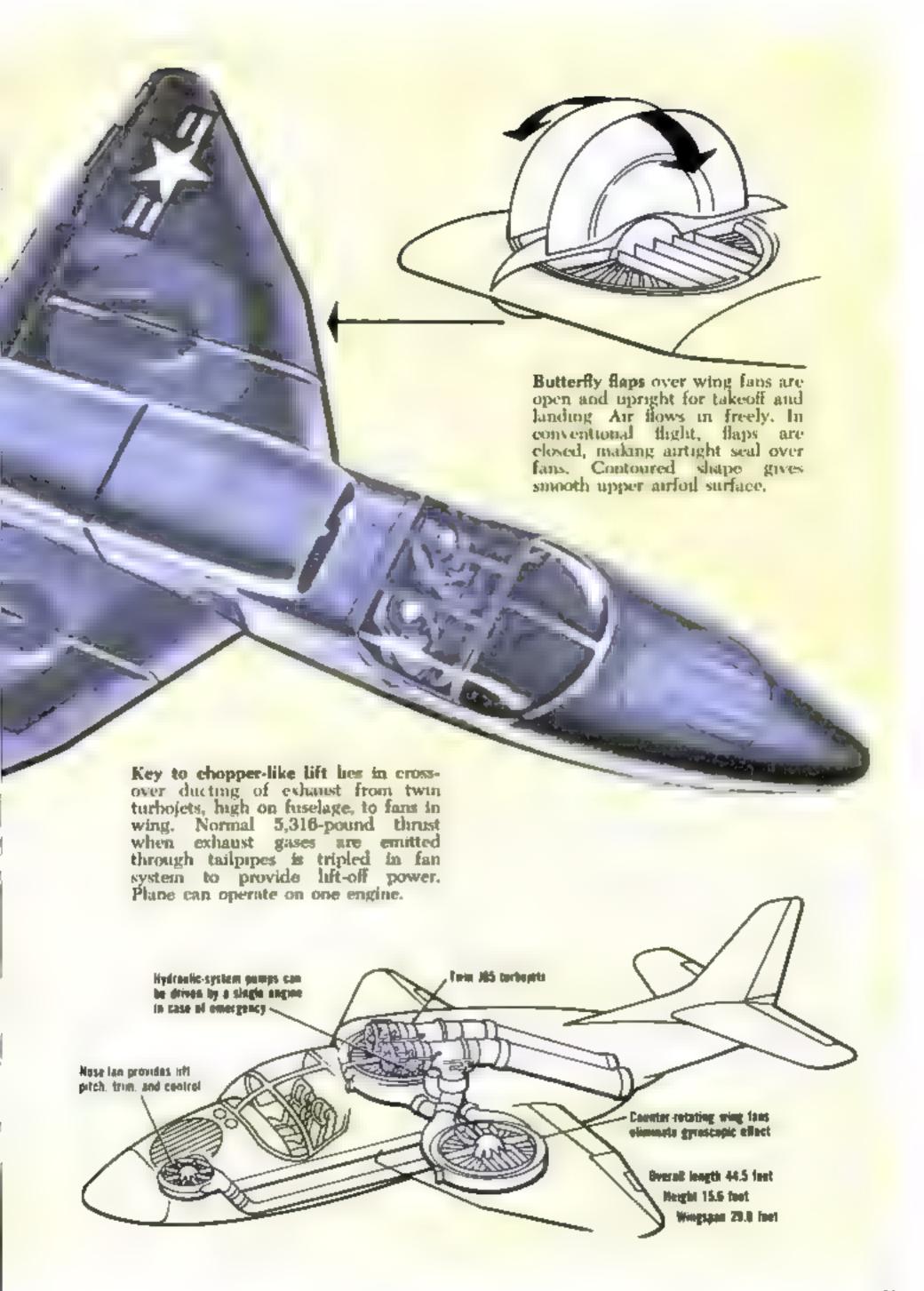
A full-scale mockup of the Army VZ-11, a joint creation of Ryan Aeronautical and General Electric, was recently unveiled at San Diego. Two planes are to be built and tested by July, 1963. POPULAR SCHNCE readers got their first report on the VZ-11 [Sept. '60, p. 78] when it was still in the

doodling stage.

What the Army wanted was a fast plane that could "live with the troops." It had to be able to rise or alight in a small space, on relatively unprepared ground. The doodles firmed up into the VZ-11. Besides handling reconnaissance or target-hunting chores, the plane can be adapted for use

as an interceptor, bomber, or troop-carrier.

The remarkable feature of the lift system, thoroughly tested in wind tunnels, is that the wing fans almost triple the basic thrust of the engines. Furthermore, the exhaust twirls the wing fans at only 2,600 r.p.m., about as fast as a small-plane propeller spins. Consequently the downward rush of air is not so hot or violent that it would set afire or tear up the takeoff area.—Wesley S. Griswold.





Flaming gasoline in 200-square-foot pool is put out quickly by 27 pounds of Purple-K powder.

New fire fighters: Purple-K and FE 1301

Two new fire extinguishers—one charged with a dry powder, the other with a gas—are rated the most effective vet to reach the public against gasoline and electrical fires.

The first is called Purple-K because a purple-red flame results from its contact with fire. It was developed at the Naval Research Laboratory. It's potassium bicarbonate, rated twice as effective for inflammable liquids as older sodium bicarbon-

Freon FE 1301 is nonconductor and safe to use on electric wiring. Since it's a gas, it leaves no residue to be cleaned up later.

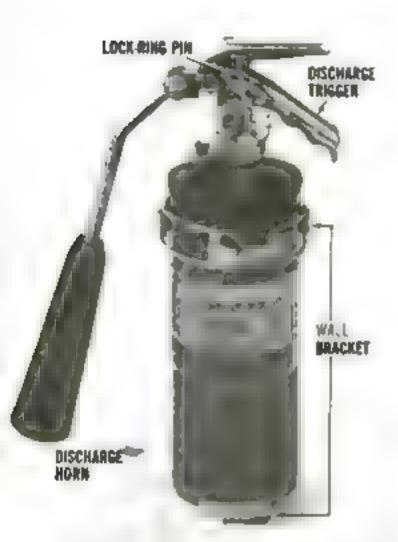
ates. The chemical remains inactive in the cylinder until pressurized by puncture of a carbon dioxide cartridge. It's put up by Ansul Chemical Co., Marinette, Wis., in extinguishers holding 4% to 300 pounds.

The gas is liquefied compressed bromotrifluoromethane, called Freon FE 1301 Developed by DuPont, it has been adopted by the Army Corps of Engineers, approved by the Coast Guard for small boats, and is used on most U.S. airliners because of its light weight. A six-pound Spartan unit, made by General Fire Extinguisher Corp., Culver City, Calif., and containing 2% pounds of FE 1301, is rated as effective as an 11-pound cylinder of carbon dioxide. The chemical has high dielectric strength, making it safe for high-voltage fires. Being a gas, it leaves no residue to damage even delicate electronic equipment.

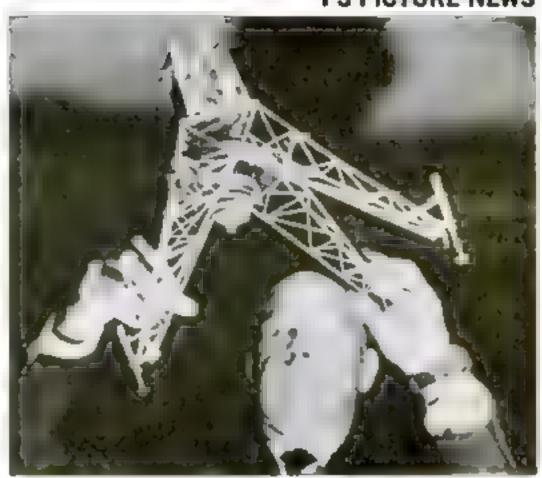
Both rate high for inflammable-liquid and electrical fires, but Purple-K seems best on the former and FE 1301 on the latter. Neither is as effective as water on a deep-seated blaze in ordinary combustibles because they lack water's penetrating power. But either will do a good job if used while the fire is still on the surface.



Puncturing seal starts action in Ansul fire extinguisher by pressurizing Purple-K powder for flow through hose to squeeze nozzle.



Spartan extinguisher is charged with 2% pounds of liquefied, non-toxic FE 1301. It does the work of older, much larger extinguishers.



How bug will land us on the moon

The spindly thing above isn't from a boy's Erector set. It's a model of the lunar ferry that will simulate landing conditions our astronauts on the moon will encounter. Two of these "bugs" are being built for the National Aeronauties and Space Administration for testing at Edwards Air Force Base in California next year. They will be 25 feet tall with legs 21 feet apart at the base and will be used to train the astronauts.

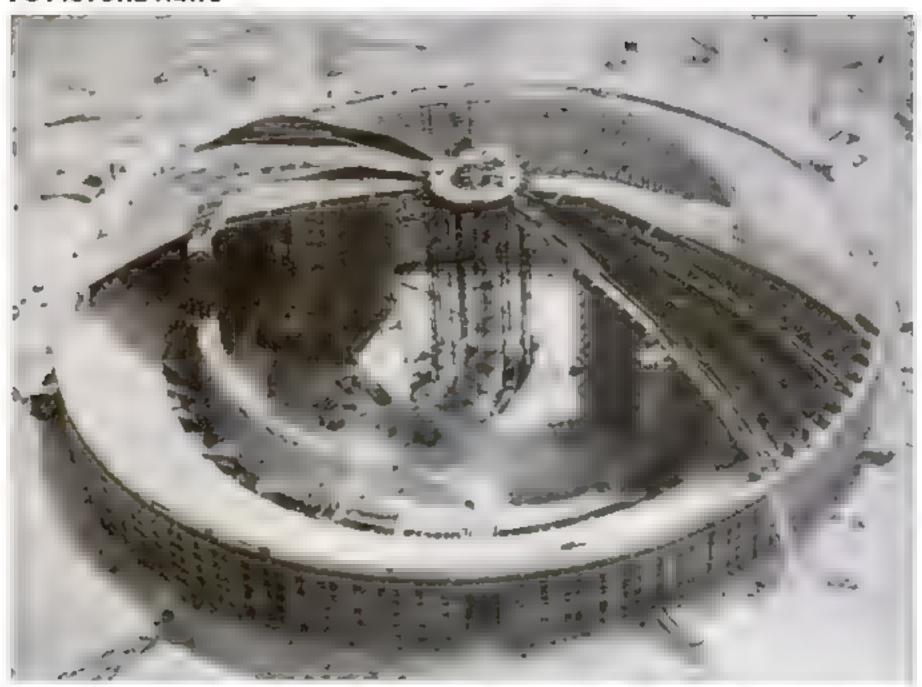
Two propulsion systems will power the trainer. One, slung under the cockpit, will be a gimbaled, gyro-stabilized jet fan; its thrust will offset five-sixths of the trainer's weight to simulate "moon weight." Fourteen rockets—six retrorockets beneath the cab and eight small, two-way rockets on the legs, for horizontal thrust—will control direction.



Spreader works like a lawn sprinkler

A machine that spreads slurry fertilizer may soon help farmers grow better crops. The singer, designed by Edward J. Funk and Sons, Kentland, Ind., contains an agitator powered from the take-off on the truck or tractor hauling it. This keeps the heavy liquid constantly stirred. Its arms rotating like a pair of inverted lawn sprinklers, the machine covers a 40-foot strip at 10 m p.h. It can be set to spread 100 to 1,000 pounds per acre

PS PICTURE NEWS



Creased concrete dome was east in 15-degree segments extending from reinforced center ring.

Pillarless roof for indoor stadium

A pleated concrete roof 400 feet in diameter covers the University of Illinois' indoor stadium at Urbana, marking a new feat in architectural design and engineering.

The buckling resembles two huge saucers, one inverted over the other, with no posts to obstruct the view from any of 18,000

tiered seats, half of them below ground.

A temporary tower at the center acted as a support while a center ring of concrete was cast: 43 feet in outside diameter, 214 feet inside diameter, and four feet thick. Forms for the rest of the roof were curved down to the perimeter, held

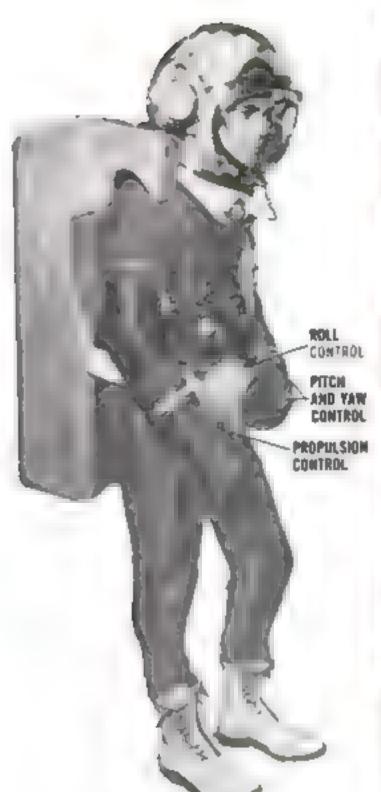
by scaffolds, and poured in diametrically opposite segments to even the load.

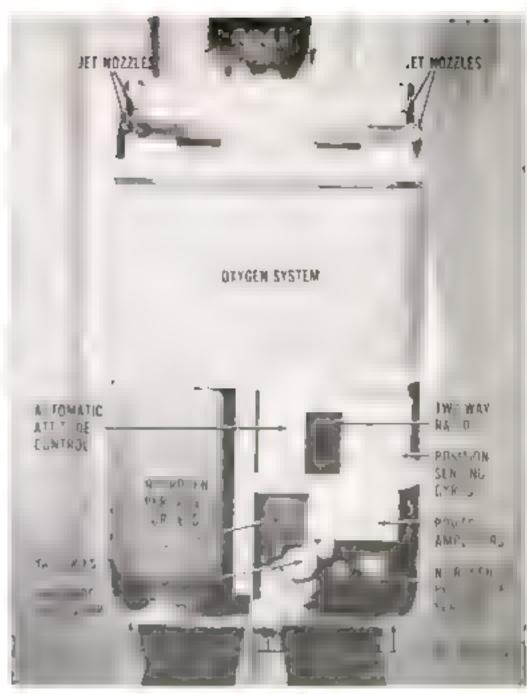
After the entire roof had been cast, engmeers wound 642 miles of %-inch steel wire—in 44 layers and under 125,000-pound tension per square inch—around steel spacer bars below the roof permeter. The resulting inward pressure on the dome raised its center 2% inches off the tower, which could then be removed.

Huge roof is intricately folded shell of 34-inch concrete laid over two inches of insulation.



4 POPULAR SCIENCE NOVEMBER 1962





Rear view of space pack, with cover removed, shows principal parts over apparatus, radio, jet mazles, hydrogen perovide fuel supply, and automata attitude control. Waist mounted control panel (left) selects and fires propolsion jets. Pack weighs 160 pounds on earth, 25 on the moon, and zero in weightless orbit

Jet pack turns astronaut into human spacecraft

By donning a new Air Force back pack, a space-suited astronaut becomes a human spaceship. Self-propelled by nitrogen-pressurized hydrogen peroxide jets, he could leave a mother craft in orbit for up to four hours and venture on his own more than two miles away. The pack, developed by Chance-Vought, would enable him to transfer from one spaceship to another, or help assemble a space station or vehicle from materials boosted into orbit. It could be used for exploring the moon, too.

A breathing system to provide fresh oxygen and remove exhaled carbon dioxide occupies most of the pack's upper half. A two-way radio keeps the wearer in touch with other members of a space crew on the loose, and with the mother craft.

Ten gas jet nozzles on the pack fired in selected combinations, propel the astronaut forward, backward, up, down, or correct his attitude in space. Using a jet-control

panel strapped to his waist, the astronaut may maneuver to a desired position; a gyrocontrolled automatic system will then maintain him in that position, leaving his hands free to work on space chores.

Four men with these packs, the Air Force suggests, could maneuver 50 tons of orbiting spaceship parts at one-foot-a-second speed and then bring them to a stop in position for assembly in space. They could make three round trips 1,000 feet from the mother ship before stopping to refuel.

On the moon's surface, the back pack would double the distance of the prodigious leap an unaided man could make and then, acting as a retrorocket—would ease him to a gentle landing.

Called the SMU (Self-Maneuvering Unit), the experimental back pack will get its first trials in jet-aircraft flights along trajectories that provide brief periods of weightlessness for those inside.



In a fog? Lost at sea?

Tune in Radar

SOMETHING new in maritime safety is now being tested in New York lambor. If it proves itself, it may be the greatest boon to harbor boaters since the buoy.

Popular Science hopped aboard a Coast Guard cutter at the tip of Manhattan, recently, for a demonstration. As Lady Liberty danced past on starboard, we climbed to the chart room where an ordinary TV set squatted on a corner shelf, babbling away with a familiar panel show. It wasn't there to entertain the skipper, however. As we plowed through the Narrows toward the Atlantic, he leaned over to switch to Channel 47—a UHF channel the

[Continued on page 208]

Chart of area scanned on screen shows how easy RATAN is to read

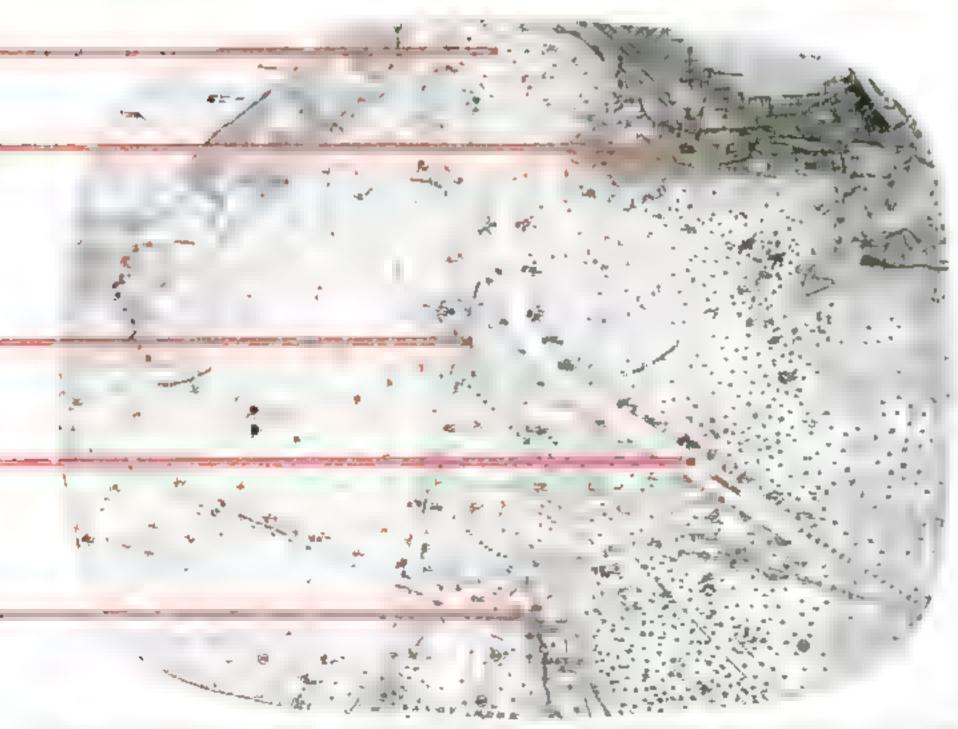


Channel markers resemble street lights. Cometlike blips between markers at lower right of

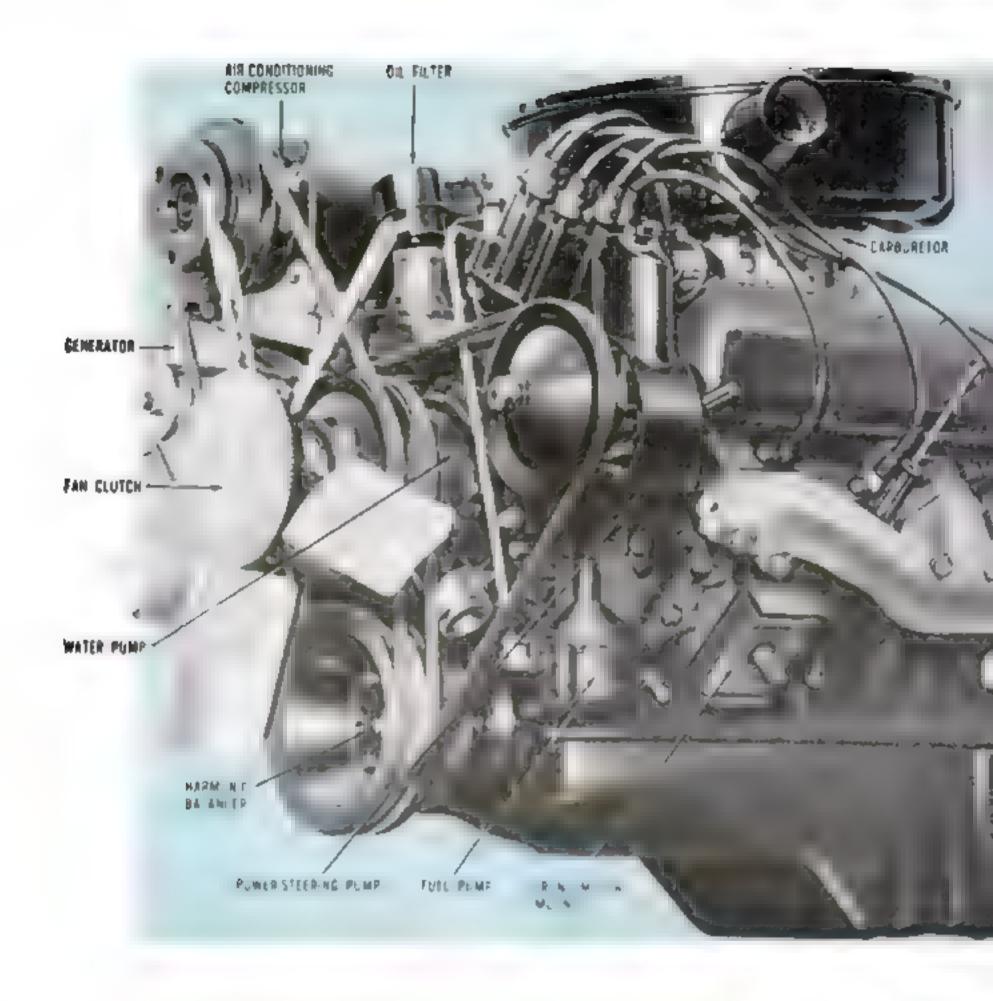
on TV

Ordinary UHF-VHF TV set brings in the radar image; no modifications are necessary. Tracing of the radar-scope repeats goes so fast that the blips leave a wake. Thus each ship's direction of travel and approximate speed are indicated. Station break every half-hour warns that the system isn't for official use—vet. Transmitting tower (opposite left) is at end of New Jersey sand spit. Scanner turns, sweeping busy shipping lanes.





screen are incoming ships. Manhattan is off top of screen and chart; open sea is to right.



The casual eye will see little change for '63—but take another look

By Robert S. Ball Jr.

HE reigning monarch of U. S. having cars the Cadillac, what else?—reached some sort of an anniversary last August. It turned out the last block, pistons, and accessories for an engine that it had used, with periodic modification, for 14 years. Total produc-

tion in that time: a whopping 1,751,500.

When Caddy started up its factory machinery for the introduction of its 1963 models last month, it began pro-

ducing a brand-new engine.

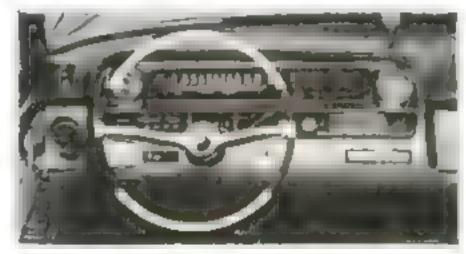
Member of the family. The new power plant was in keeping with the automobile's conservative traditions. It was still made of east iron. It had the same displacement as its predecessor and even the same horsepower. Bore and stroke and compression ratio remained unchanged.

Then what was new in this engine. two years and more in gestation?

Caddy Produces First New Engine in 14 Years



That roof line, with "ear muffs" at stern and smaller rear window, does little for vision, but it's the height of '63 fashion.



Instrument panel has been inched toward driver. Multiplex adapter is option with FM radio.

Two things stand out. It's lighter by several dozen pounds than last year's motor. (Cadillac engineers like to point out that the Rolls-Royce aluminum engine, seven cubic inches smaller, is actually heavier.) Second, most of the engine accessories have been regrouped in front for easier servicing.

Trimming off the fat. To lighten the engine, designers shaved nearly half an inch off the tops of the blocks, then shortened the connecting rods to keep the same compression. They cut down the length of the block by more than an inch. They hollow-east the crankshaft,

which is 11 pounds lighter than its '62 counterpart.

A switch to a 42-amp alternator-rectifier system (52 amps in the Series 75 model) saved another 10 pounds. This new unit is about the size of a heater's blower motor.

The front engine cover, the only major aluminum casting under the hood, supports the generator, steering-gear pump, distributor, oil filter, and the water, oil, and fuel pumps.

Among the virtues this adds up to is easier timing. With last year's engine, one mechanic had to turn the distributor



Constant-velocity joints are used at center and rear of drive shaft to reduce the slight vibration and noise set up by ordinary U joints. This is the rear one, at the differential.

(mounted toward the rear of the block) while another read the timing light.

Damping the noise. A more gimmicky innovation is the centrifugal viscous clutch on the five-bladed radiator fan used to pull air through both radiator and condenser on Cadillacs fitted with air conditioning.

Using a thermostat-controlled valve to measure out a silicone fluid between two clutch faces, the fan will barely turn at low engine speeds and low outside temperatures. It will speed up to 3,200 r.p.m. at high outside temperatures and highway speeds. The reason for keeping fan speed down: noise reduction. It also saves a bit of power.

There are other, minor modifications under the hood. The carburetor and positive crankcase-ventilation valve have been tinkered with.

In the light of today's horsepowers, Cadillac's engine of 1949 sounds, in the telling, almost like a caricature of yester-year. It displaced 331 cubic inches, had a bore and stroke of 3.187 by 3.625

inches, a compression ratio of 7.5:1—and produced all of 160 horsepower.

That engine's immediate predecessor was called the "348" after its cubage. It had a bore and stroke of 3.5 by 4.5, a compression ratio of 7.25:1—and produced 150 horsepower.

With the passing years the cubage of the 1949 engine rose to 390. The bore and stroke became oversquare—4 by 3.875. The compression ratio climbed to 10.5:1, the horsepower to 325.

With a disdain for Detroit's now-resumed "horsepower race" that only a car of Cadillac's breeding can exhibit, the power of the new engine remains exactly the same—325.

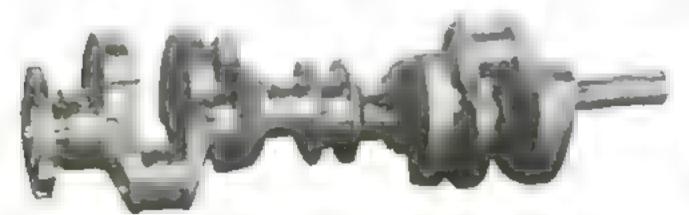
More sprightly in the joints. For '63, Cadillac also has made significant changes in the chassis for silence and durability. Throwing cost considerations out the window, the company put two constant-velocity universal joints in the propeller shaft as well as an ordinary U joint. The CV joints are in the middle and rear of the drive shaft, the U joint just aft of the transmission.

Constant-velocity joints, by eliminating the small variations in shaft speeds in each revolution, reduce vibration and, therefore, noise.

Cadıllac held up use of the CV joint for several years until long-life operation could be assured. Buick, too, employs them. Some foreign cars have used them for many years.

There is more to the Caddy's chassis

[Continued on page 210]



Eleven pounds lighter than last year, crankshaft is hollow-east of heat-treated iron alloy. Main bearings are cored out to take the thicker shaft. Shorter pistons help reduce weight, too.



Shoe magnets improve foothold. Batterypowered electromagnets in these strap-on sandals would provide a surer footing on any steel surface (such as a wet or pitching carrier deck) when the wearer switched them on. This recent patent, assigned to the Air Force, would use rubber pads to skidproof and cushion the soles.

New ideas from the inventors

Seat turns skate into coaster. Strapped and clamped onto an ordinary roller skate, this seat would become a sled for downhill coasting. On a level surface, the inder would propel himself by pushing along the ground, He'd guide and balance the sled by shifting his weight.

Mop bends under furniture. Housecleaning might be made easier by a mop handle like this. A section made of thin metal rods would bend under pressure to allow the mop (or a broom, waxer, or paint applicator) to maneuver under and between furniture and other low objects.





More inventors' ideas



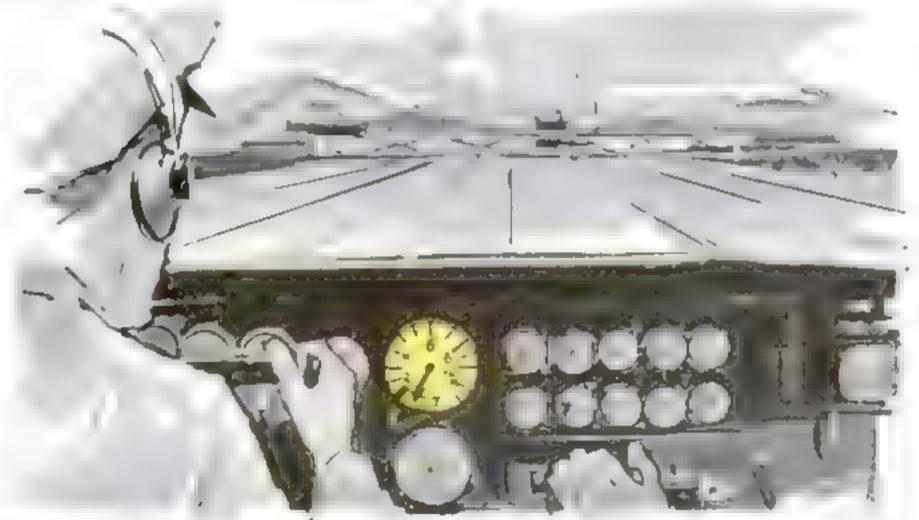


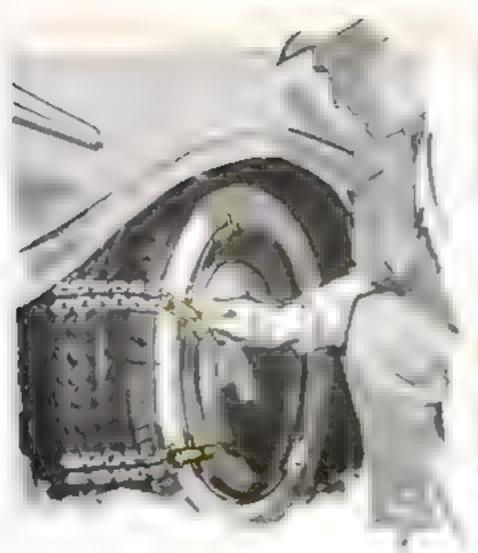
Rack unfolds from wall. Tucked into an out-of-the-way corner, this collapsible, wall-

mounted rack would be set up in a juffy to provide creaseless coat-hanging space at parties or family gatherings. To knock down the rack, you'd slide the collared vertical support against the wall, then drop the hinged horizontal bar.

Runway gauge monitors takeoff, For safer jet takeoffs, this Sperry patent would compute speed against remaining runway and give a one-dial reading of the result. At a Fork lift fits barrow. With this upwardangled fork attached to the bucket and axle of your wheelbarrow, you could take advantage of the barrow's built-in leverage to engage, lift, roll, and dump rocks and other heavy or bulky objects. When it wasn't needed, the fork would be removed and folded for compact storage.

critical point on the runway the dial would tell the pilot if he had enough speed for a safe takeoff, or if he should brake and taxi back to start the long run again.





Skid chains clip to rim. Hooked to the rim on each side of a tire, these clips would let you attach or remove snow chains quickly and without a jack. Cross chains would be fitted with snap-on clips that would engage the rim clips. The system, says the inventor, would also allow you to use "chains" of material other than metal.

Drum washes paint roller. Instead of scrubbing water-based paint out of a roller, you might let this cleaning drum do the work for you. You'd lock the roller to the drum handle and connect a hose to the inlet. Antisplash vanes would direct the flow to rotate the roller against the inner wall of the cylinder.





Carpenter's vest jacks panels. You wouldn't have to juggle overhead beams or ceiling panels if you wore a pack-fitted vest like this. You'd position a panel, then crank up the supporting arms. They'd hold the panel, freeing both hands and eliminating need of a helper to nail it in place.

The fell-wave patents have been asked in these incontions. Shoe magnets No a test 178 to J. F. Nucl. dson and D. W. Nam. Pauton, Chao. Sled-No. 3 039,784 to M. B. Davis, Mahren Pa. Mop. No. 1045 269 to M. M. Coffman and W. M. Vanderpood, Rickford, Ill. Rack-No. 1039 617 to A. Nuclet University City, Mr., Fork No. 1039 617 to A. Nuclet University City, Mr., Fork No. 1039 617 to A. Nuclet University City Mr., Fork No. 1039 617 to A. Nuclet University City Mr., Fork gauge, No. 1034 036 to R. V. Crandiack, New Hyde Park, N.Y. Chain, No. 1044 517 to W. R. P. Delano, Scianker, N.Y., Washer, No. 1047 516 to L. O. Leach, La Grande, On. New No. 1039 705 to N. M. Tate, Jophin, Ma.

Copies of patents may be released by mucher, from the Commissioner of Patents Washington 35 DC, at 25 cents each. To write to no invotor if the address aren above is insufficient, address ten by name and patent number) in case of the Commissioner of Patents.



Suspended 56 stories high above controls in yon, workmen give I are State in a refinishing lamestone extent, position was been

It is politic, stray of stind as steel trim
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Scrub Team in the Sky

The 1,250-foot walls of the Empire State Building are being refinished for the first time in 31 years

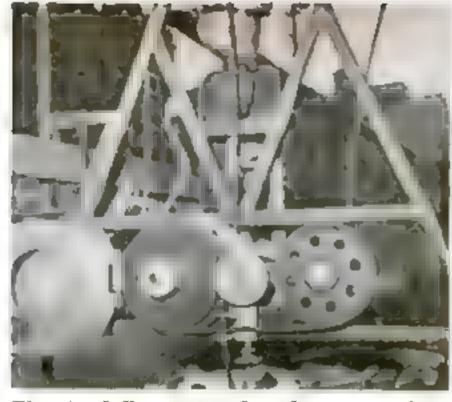
ALMOST a quarter of a mile below us, New York City's streets were only narrow ribbons. Toy cars moved, bumper to bumper. Clusters of hurrying dolllike figures added noise and confusion.

But near the top of the world's tallest building, photographer Bill Morris and I heard nothing but the occasional whirt of small electric motors. Workmen on motorized scaffolds were creeping up the sides of the Empire State Building, giving it the first face washing since it was built 31 years ago.

Leaning out over a low, windswept parapet 80 floors up gave a dizzying view. Bill fearlessly hopped over the parapet and onto a swaying scaffold to get the shot at the left. (A few days later, two painters had a close call when their scaffold slipped. One managed to hold onto the scaffold. The second slid safely down the cable from the 18th to the 11th floor. Another scaffold failure on a nearby skyscraper killed four workmen.)

What does it take to refurbish a 500,-000-square-foot exterior and 6,500 windows? All of 3,000 gallons of limestone coating for walls, 250 gallons of paint to cover metal window frames after wire brushing, and gobs and gobs of calking to refill defective mortar joints. Cost: over \$200,000.

The job, begun in May, will end in November—a total of six months. Ironically, the building was constructed in little over a year.—Alex Markovich.



Electric drills, equipped with reverse, drive scatfolds up and down. Clambing rigs are used because of height of building; reeled 1,200-foot cables would add too much extra load to scaffold. Cables are %-inch, rated at 9,000 pounds.



Scaffold can be winched by hand in case an electric motor breaks down. Safety lock prevents scaffold from falling during failure.



Before and after sections of building show grimy wall, discolored steel trim at top. Below, lonestone is painted and trim polished.

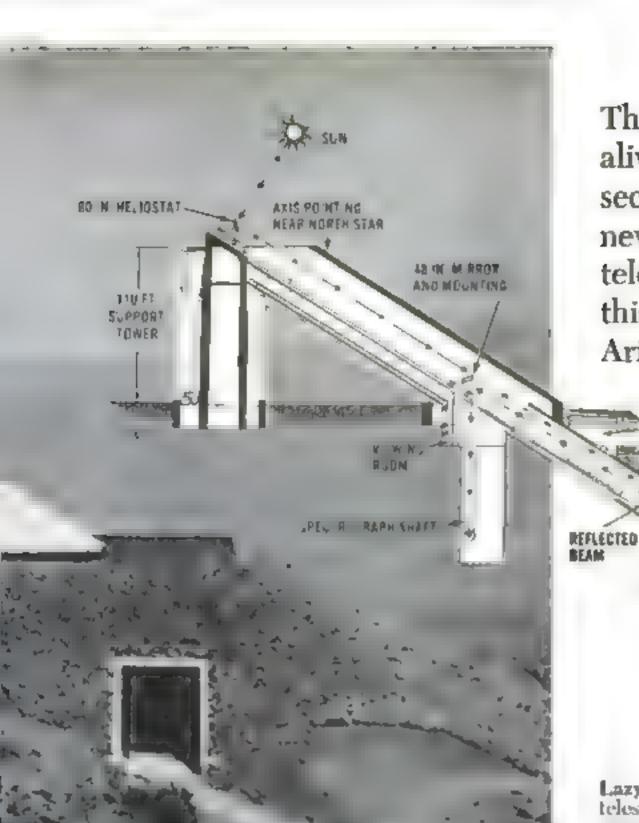


A Big Eye to Spy On

By Frank A. Tinker

SILHOUETTED on a gaunt and isolated mountain top in southern Arizona is a \$4,000,000 structure that looks like a launching chute for monster skyrockets or a giant figure 7 fallen on its face. It is a solar telescope—the world's newest and biggest eye to stare at the sun's face. This month marks its official dedication. The sloping back of the lazy 7 is the telescope's shaft, a 480-foot tunnel half buried in the mountain itself. Step inside and you see what looks like an awe-somely steep railroad track running from the open sky above to the depths of rock below.

Mounted on those tracks are rail cars that can carry the telescope's three huge mirrors to a shaft-side aluminizing room when they need recoating. One car will



The star that keeps us alive may yield some of its secrets to the world's newest and biggest solar telescope to be dedicated this month on an Arizona mountain peak

Lazy 7 atop Kitt Peak is housing for solar telescope. At left is 110-foot tower that supports the big 80-inch mirror. Light from it bounces down to a 60-inch mirror at base of shaft, then up to a 45-incher at ground level. Directly below, bright image, 34 inches across, shows up on a white table top in the viewing room,

AND MOUNTAND

RAIL TRACKS

the Sun

have the added job of bringing in the hefty top mirror—an 80-inch wide, twoton quartz disk called a heliostat—when weather threatens.

The telescope will be aimed at a point near the North Star, a fixed position that will allow the mirror to track the sun in its daily course by moving through one plane only.

The sun's image, reflected from the heliostat, will first hit a slightly para-



Railroad tracks run the full 480-foot length of the solar telescope's steep shaft. Camera fans might well marvel at the focal length of the optical system: more than 300 feet.



Grinding the 84-inch mirror (above) for a new telescope at Kitt Peak took months of expert work in the observatory's Tueson shops. The mussive Pyrex disk is now being tested.



Seventy-ton framework for million-dollar 84-incher is in place, and telescope—fourth largest in the U. S.—may be in use by Christmas. Plans call for a future 160-inch scope.



Ribbed with copper coolant tubes and coated with heat-shedding paint, telescope's tower unloads 85 percent of the exterior heat. Inside, heat varies by no more than two degrees.

bolic 60-inch mirror at the base of the shaft, then bounce up to a 48-inch ground-level mirror, and finally strike a white table top in a viewing room directly below the third mirror.

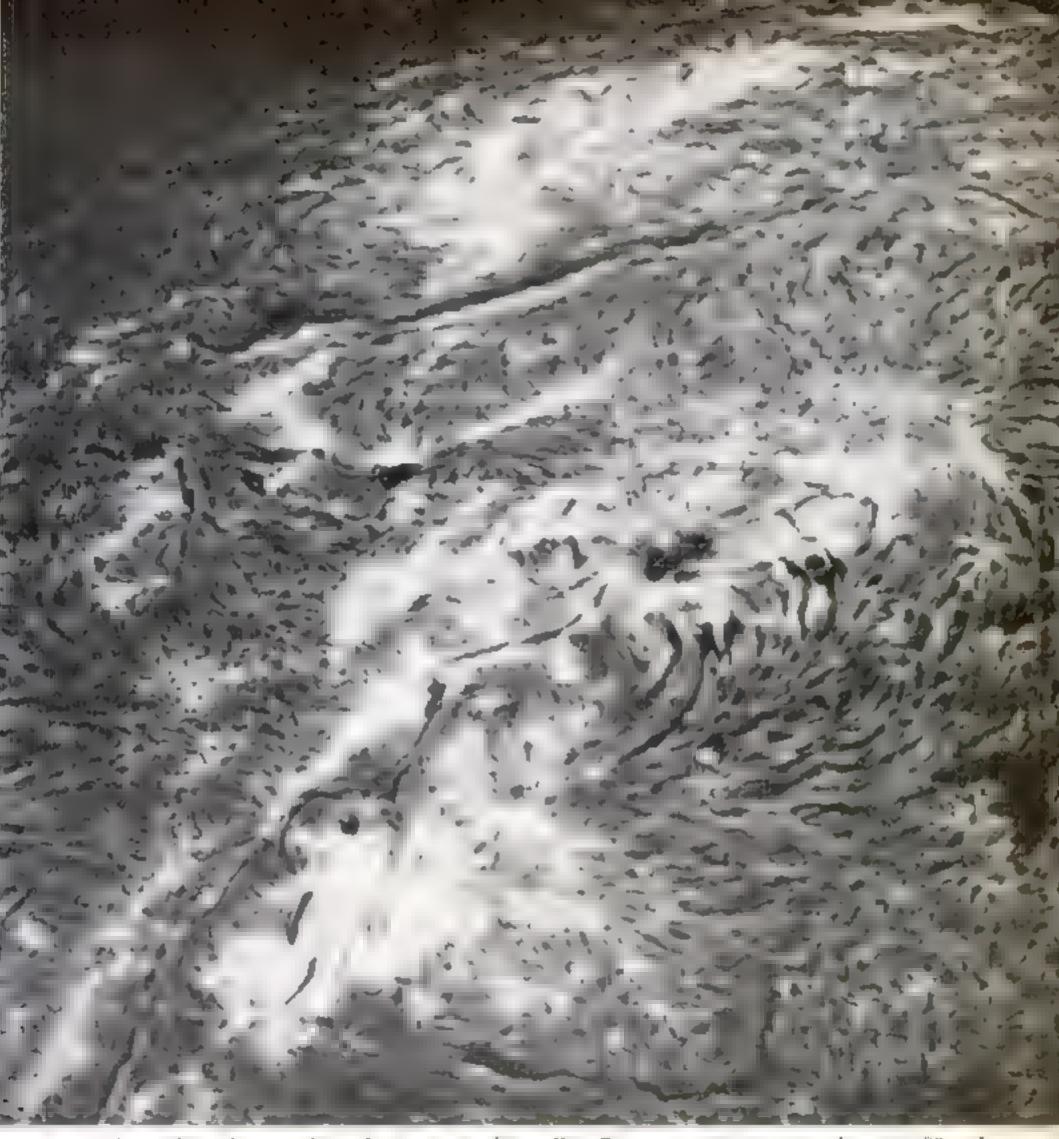
Brighter than by noonday sun. There details of the sun's surface will show up on a glowing disk, 34 inches across and twice as bright as a piece of pure white paper seen in the noonday sun. The image will also be twice as large as any obtained with previous solar telescopes.

Astronomers, wearing dark glasses, can study the sun on the table top if they wish. But, as one remarked, they almost never use their own eyes in observing the heavens—too unreliable, too easily tired. They depend on cameras and delicate light-measuring and analyzing equipment instead. One, a remarkable vertical spectrograph, can stretch out the solar spectrum to a dazzling rainbow band 70 feet long.

This kind of analysis "will give solar researchers more revealing views of the sun than have ever before been possible," says Dr. Alan T. Waterman, head of the National Science Foundation. What the solar telescope can reveal about the sun's life and behavior—its radiation, spots, and flares—may also be vital to the U. S. space program.

This is one reason why a number of

[Continued on page 184]



Sun's seething fiers surface slows up in this care. Mont. Was to Observatory part graphs

Kitt Peak is tonomers tope the new 80-meh telescope will vibli even time striking shots

Do you remember Popular Science two years ago?

If you could read the tiny print you'd see that Popular Science reported on the solar telescope almost two years ago (Jan., 1961). The telescope's mirrors were barely gleams in the designer's eye then. Now a new highway has been built and a host of domes have mushroomed on the Arizona peak.



PS PICTURE NEWS



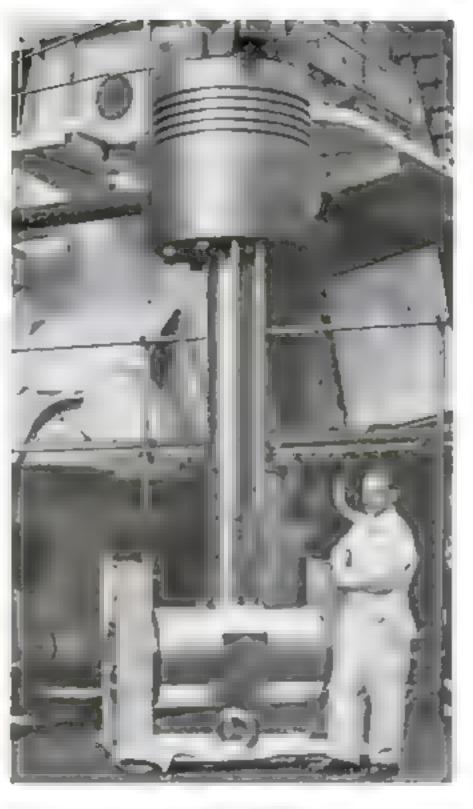


A tilting platform in Russia unloads ordinary trucks as fast as dump trucks on the ground can unload. It can take 25 tons: two trucks at a time or a truck and trailer. Access is by a drive-on ramp. Chassis are held on by clamping bars and support blocks so they won't sag on their springs when tilted for dumping

"Compact" jet for short-range flights

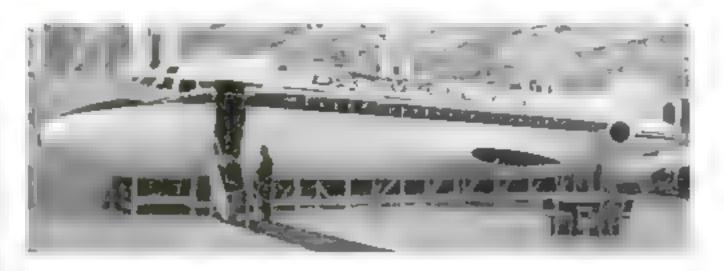
The sleek job at the right is a full-scale mock-up of a small jet airliner proposed by Douglas to bring jet speed to cities now served only by pistonengine airliners. The 96.4-foot plane would

shuttle between airports 100 to 1,000 miles apart, carrying 56 to 74 passengers, and settle down on runways too short to ac-



Giant piston for big diesel

The huge piston above, with a five-foot stroke in a three-foot cylinder bore, will be part of the biggest marine diesel ever built in the Netherlands. It's one of nine for the engine, which will churn out 20,700 hp. at 119 r.p.m. The diesel will be installed in a 32,000-ton tanker that's under construction for a British shipping company.



commodate big transcontinental jets. With swept-back wings and two turbofan engines in the tail, it would cruise at 530 m.p.h.



The last word in ship models: A 39-Foot Man-Carrying OUR sense of proportion reels at sight of the Bremen IV Jr. Roll-Ocean Liner

By Harry Walton

ing at the dock on a windy day, she looks like an expensive wind-up toy. But go nearer, and she's every inch a transatlantic liner, from the name on her bow to the 3.225

windows and portholes in her hull and superstructure.

Every davit, bitt, and capstan is in place. Her 22 lifeboats, shrouded with canvas, are shipshape. Rigging on masts and cargo booms is meticulously exact.

Then the bridge deck lifts, a human head rises-enormous under it-and you realize this is a super-detailed, mancarrying model.

Built to a scale of 1 to 25, it is over 39 feet long, almost 6 feet wide, and



Triumphant builders with sound-alike names, Gunter Buse (left) and Gunter Bos, worked on their model more than 10 years. Neither man is connected with the sea or shapping.

11½ feet high from keel to mast top. There are 7,000 feet of planking, 23,000 copper nails, and 950 feet of railing in the model. Her dead weight is 10 tons, displacement 12.

The hull is of doubled wood planking overlaid with sheet iron, the deck 14" oak reinforced with wood and iron underneath. Two 38-hp, Mcreedes-Benz diesel engines give a cruising speed of seven knots. The engines, controllable from the pilot house, are direct-coupled to two reversible-pitch props, doing away with bulky reversing gear.

Besides the pilot house (which holds a minute galley), there's a day room, a four-bunk cabin, engine room, and head. Access is through deck hatches.

Few modelmakers dream as big-or

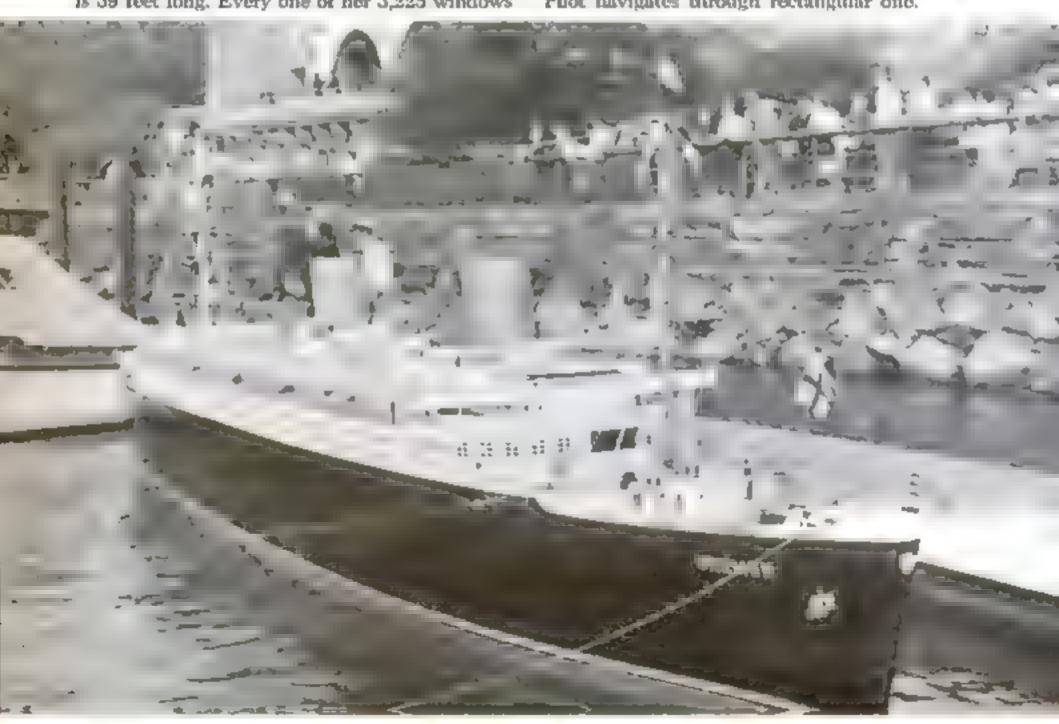
as steadfastly—as the two land-locked West Germans who built this replica of a 51,735-ton sea queen. Gunter Buse was only 13 when he saw the real Bremen IV, along with its sister, the Europa, Germany's biggest liners. The boy was fired with the idea of building a super-detailed model on a scale befitting the holder of the Blue Riband for fast Atlantic crossings.

World War II intervened. In 1943, on an island in the North Sea, 17-year-old radioman Buse met an ex-steward of the Bremen whom he pumped for information. Discharged at 19, Buse went home to the inland city of Osnabrueck, got a job, and built a shed from rubble to work in.

No blueprints of the Bremen IV—destroyed by fire at her dock during the war—could be found, Working from pictures and a small scale model, Buse laid an oak keel and started the hull. Then Gunter Bos, a neighbor, got interested. The two spent all their free time working on the model. On an old lathe bought for \$9, they not only made parts

Modeled on a grand scale, the Bremen IV Jr is 39 feet long. Every one of her 3,225 windows

and portholes is transparent and watertight Pilot navigates through rectangular one.





Tug looms over Bremen, cruising on her own at seven knots. Double bottom of bilge holds 130

gallons of oil for her dusels. Two generators and batteries supply electric power.

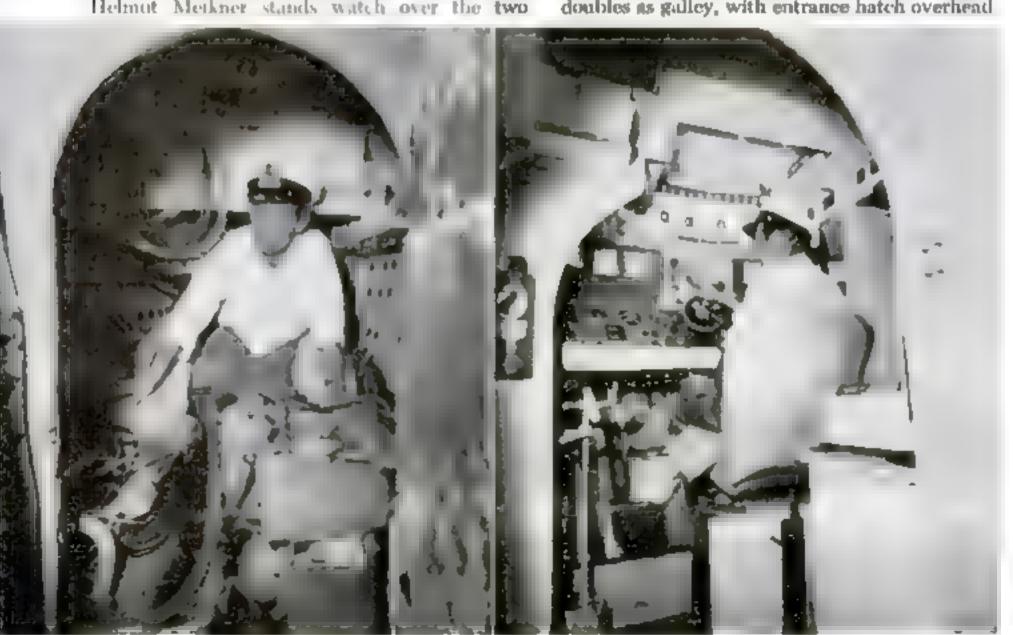
for the ship, but did subcontracting jobs to help pay for materials.

Their big break came in 1959, when North German Lloyd was about to send a new 32,000-ton Bremen to sea. Intrigued by the audacious model, they offered engines and other equipment. This spring the midget liner was

launched and headed for New York for a sail up the Hudson and through the Erie Barge Canal.

To reach the U. S. for its good-will cruise, however, the model rode the deck of a freighter. Buse's and Bos' scaled-down liner could not have braved the North Atlantic's full-size seas.

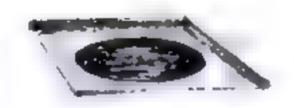
Slim to fit eramped cugue room, criwman Helmot Meikner stands watch over the two four-cylinder auto diesels. Pilot house (right) doubles as galley, with entrance hatch overhead



Eight Minutes on Borrowed Air



Descent into the Maelstrom is described by lifeguard Ray Scharf. 'Garrett Giberson was pulled down in 5% feet of water The swimning pool was being cuptied, and the vortex sucked him into the drain, like a bathtub stopper. All the water in the pool was pushing him down. Bill Knight, another lifeguard, and I couldn't hudge him. Giberson went lunp. I got seared.



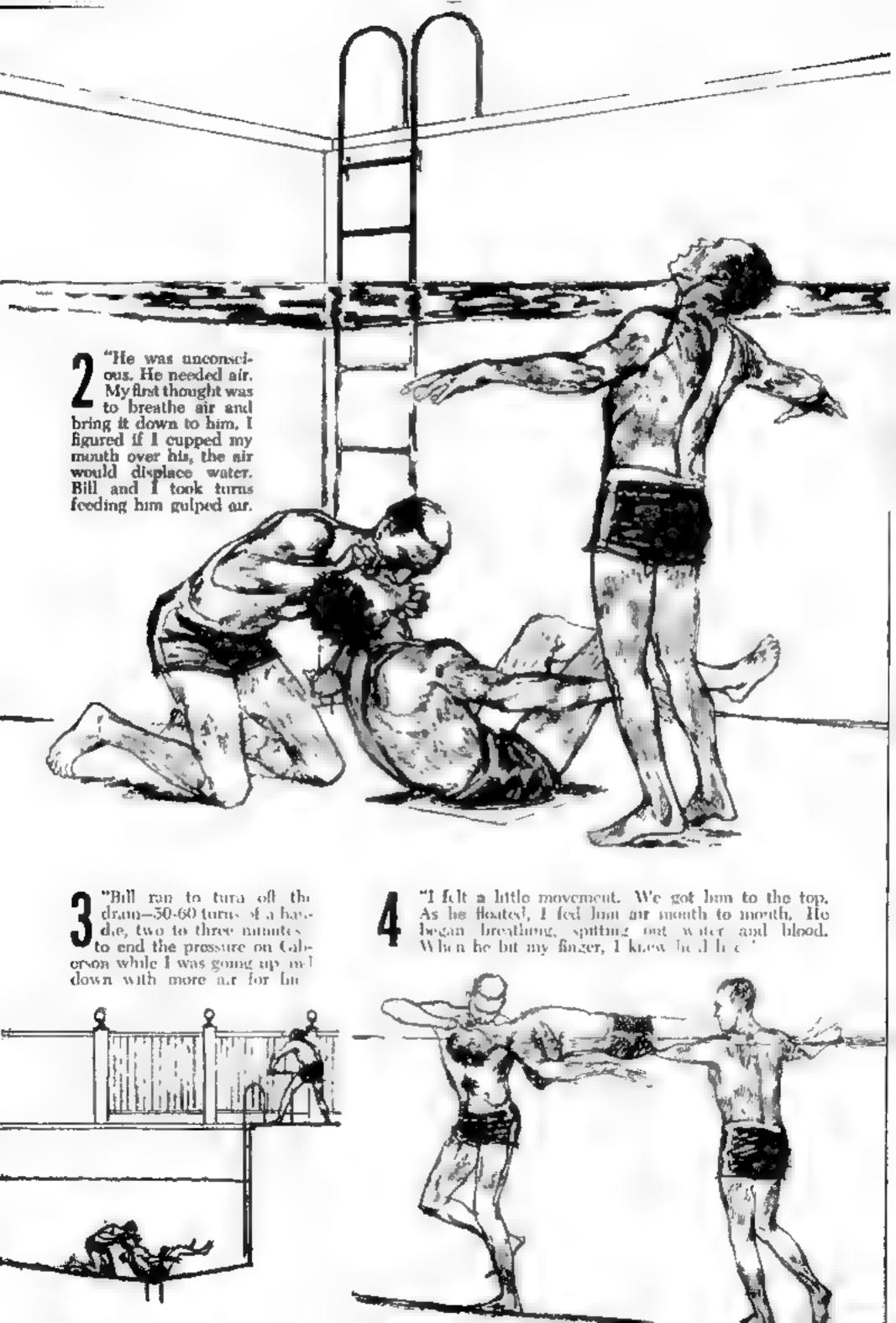
OST people rescued from drowning are submerged only a minute or less. Even pearl divers, without oxygen, usually stay down no more than 50-80 seconds. Brain damage may occur within two minutes.

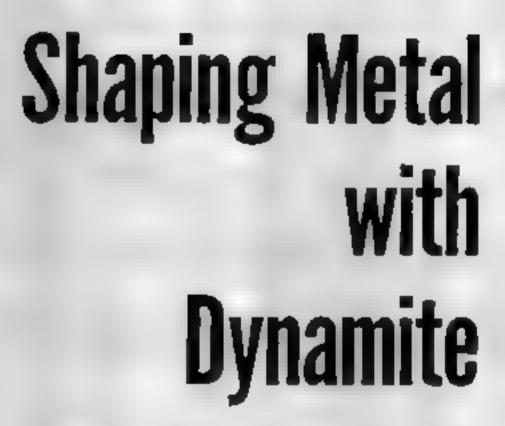
Yet, on July 30, Garrett Giberson, a 19-year-old lifeguard at an Asbury Park, N.J., pool, was trapped under water for eight long minutes; was rescued, revived, and today is alive and healthy

Giberson's life was saved by two alert fellow lifeguards—Ray Scharf, ex-college track and swimming star, and Bill Knight, center on Olivet College's football team. Mouth-to-mouth breathing under water—unheard of before this incident—was the method they used. Ray Scharf hit on it in a flash at the moment of crisis.

Says Bill Knight: "I think Garrett's excellent physical condition helped." Says Mel Long, head lifeguard at Asbury Park: "A wonderful job. Quick thinking." Says the Red Cross—now investigating the possibilities of underwater mouth-to-mouth breathing: "We have no case to compare to this rescue."

Says Giberson: "I never expected to get out of there." The drawings show how the unique rescue was accomplished.

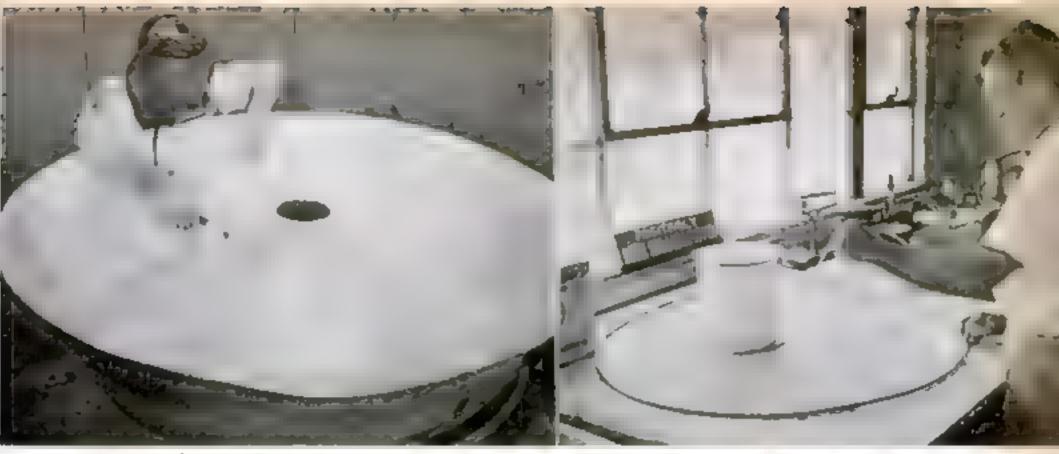




Hard-to-work substances yield like putty when new techniques hit them with explosives, 10,000volt sparks, high-speed rams, and supermagnets

By Charles J. Vlahos





Geyser shoots skyward (opposite page) as explosion turns "cake pan" above, made by welding only five pieces of sheet metal, into half of fuel tank for missile. Forming tank conventionally would take 60 percent more welding.

Explosive charge of Primacord, laid out in circle as above, is suspended in water tank with "cake pan" and die. Shock of explosion, transmitted through water, converts piece into half-doughout by forcing it against die.

BOMBS are being exploded, all over the country—to fashion pieces of metal into useful objects. By a radical procedure, called explosive forming, you can make a pretzel out of any of the new hard-to-work metals.

The explosive technique and others as novel—electrical, mechanical, magnetic—are working metals faster and more easily than ever before.

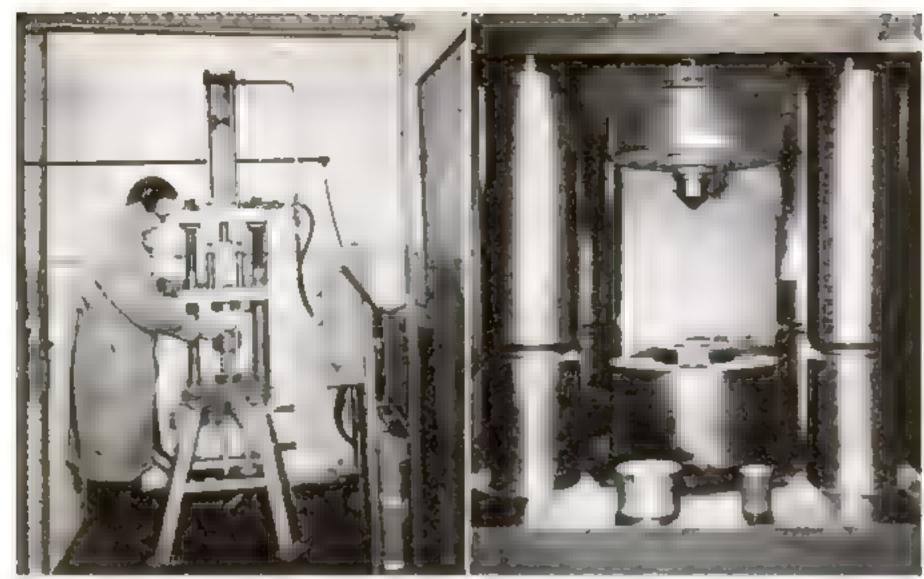
For explosive forming, you clamp the metal workpiece to a die, and remove the air between them. Then you lower them into a water-filled pit some eight to 12 feet deep, outside a plant, and set off a charge of dynamite above them.

Being incompressible, the water transmits the staggering pressure, a million pounds to the square inch, in all directions. The workpiece has to give—and is forced against the die. It's all over before the roar of the blast dies away.

Explosive forming is cheap. It takes no expensive machines, skilled labor, or scarce floor space—only a pit, water, a die, and some \$3 worth of explosive. It makes parts that could be fashioned no other way. Complicated shapes are easy, and practically any metal can be worked—including titanium and tough,



Doughout-shaped piece formed by explosion is examined by engineers. Scale-size experiment at Baltimore plant of Martin Company, was successful test of applicability of technique to make full-size, 18-foot-diameter "torus tank,"



Underwater electric spark whams metal to desired shape in electrohydraulic forming technique, applied by this Electro-Dynamics machine. Fed fast enough, machine could make pieces at fantastic 9,000,000-an-hour rate.

High-speed ram descends at up to 85 m.p.h. in Dynapak pneumatic-mechanical machine, shown fitted with dies to form steel piston cap from billet in right foreground. Other billet, of copper, is for a steel-mill oxygen nozzle.

high-strength steels. So accurate is explosive forming that fingerprints accidentally left on a die have been faithfully reproduced on the finished parts.

Forming isn't all that can be done with explosives. They're being used for sizing, an operation that corrects distortion or "wrinkling" from heat treatment, aging, or welding heat. Sizing employs smaller explosive charges than forming and can be done in lightweight tanks. Currently, large rocket cases are being explosively sized, to remedy welding distortions.

More uses may lie ahead. Scientists of several concerns, Aerojet General and North American among them, report encouraging experiments in harnessing explosive energy to cut metal, compact it, swage it, pierce it, and even plate it.

Shock waves from sparks. Akm to explosive forming is a newly developed technique, electrohydraulic forming. The only essential difference: Instead of a chemical explosive, it uses a high-voltage spark.

An electricity-storing capacitor is

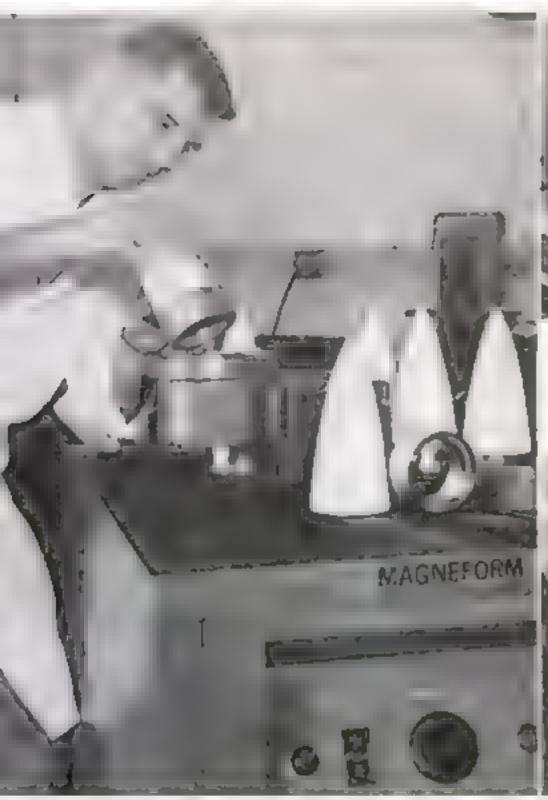
charged to as much as 10,000 volts. This stored energy is suddenly released to a spark plug submerged in water. The resulting explosion yields sunlike temperature, and shock waves of up to 500,000-pounds-per-square-inch pressure.

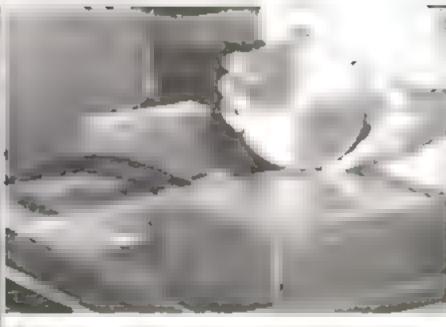
In one of the first commercial machines applying this process, a rectangular gray cabinet the size of an office desk houses a bank of capacitors. It uses ordinary current, and one man operates it, through a control panel with only one switch, one dial, and one button. The maker, Electro-Hydraulics, Inc., says the machine will successfully weld, lock, shape, blank, and pierce—all to tolerances as close as 0.005 inch.

Another maker of a machine of this type, Electro-Dynamics, Inc., calls the electrohydraulic device inherently capable of producing some 9,000,000 parts an hour—given a way to get them in and out of the machine at that fantastic rate. Today's technology and equipment, it says, could make production at 100 cycles a second possible.

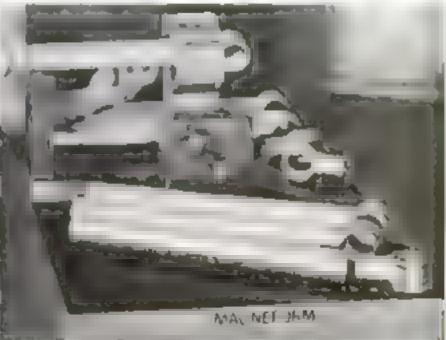
[Continued on page 182]

Mighty magnet shapes metal, in newest technique of all



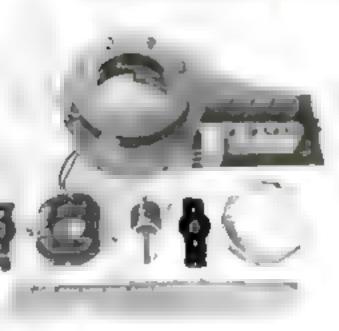


Interchangeable coils suit varied tasks, Here, a flit "paneake" coil drives aluminum disk against die to form ridged pattern shown. To compress metal, the coil goes around a piece; to expand metal, coil goes inside the piece.



Eerie unseen force of magnetic-forming machine attaches metal band tightly to ceramic nose cone for missile. For this swaging operation, piece goes in coil seen at back of Magneform machine above, first of its kind on market.

Eliminating welding, lightning-fast magnetic in white joins sections of aluminum tiding. Pulse through magnetic coil presses outer piece of tubing into all indentations and over protrusions of inner piece, assuring tight fit.

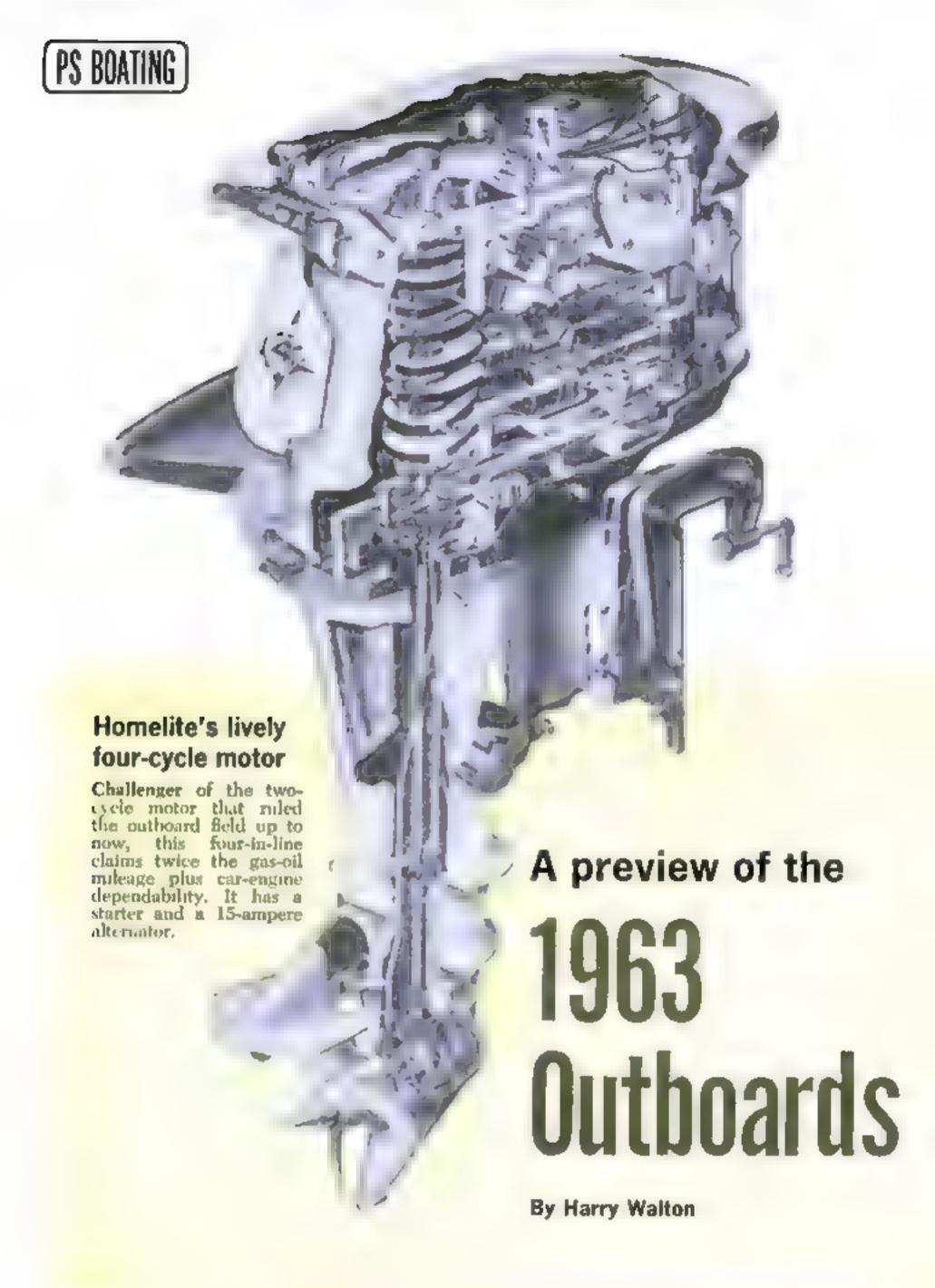


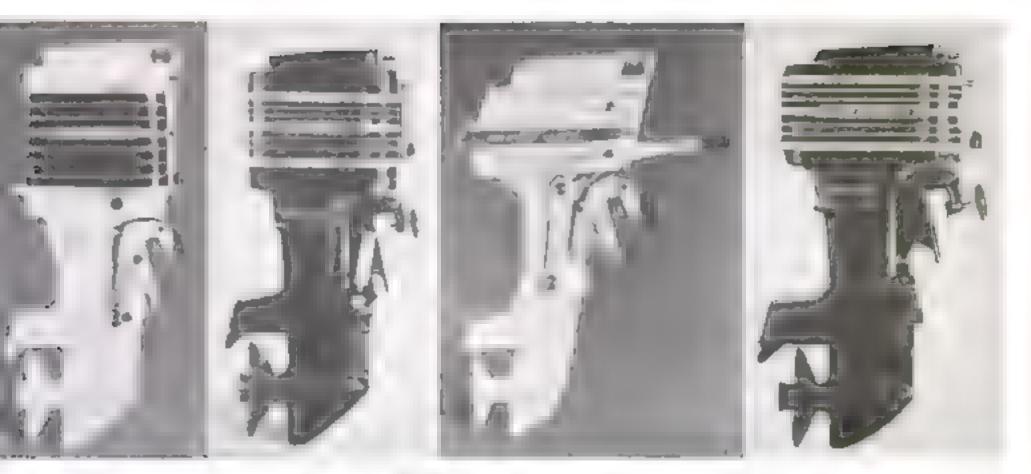
Electric-motor parts (bottom of picture) are packaged" in aluminum band at lower right by magnetic-forming machine. For this purpose, coil shown above them in picture is used.



Aluminum band and motor parts, assembled loosely within it, are placed in the Magne-form machine's coil. What happens when magnetic jolt is applied is seen in next view

Motor looks like this when removed from cott. Magnetic pulse has compressed the band around parts to bind them tightly, completing assembly Operation takes say seconds.





Four new power heads fill in the Mercury line

A high-thrust six, the Merc 850 (above, left) is for big loads at moderate speeds. Next to it is the 650, Mercury's gutsiest four-in-line and lightest in its power class. These two new motors and the Merc 500 have a new kind of manifolding said to improve idling and reduce air-intake noise. The Merc 200 (third from left) is a new 20-hp. rig. At right is the new

350, a 35-hp, motor with electric starting and alternator-generator optional extras. Also new are horizontal intake louvers for cooling water, located just below the cavitation plate in the three larger motors above. The normal water flow parallel to these shts, as the bont moves through the water, tends to flush away debris that might cling to and clog ordinary intakes

Ingenious imports, a four-cycle, and new models in the medium power range make '63 news

board horsepower race—which began with Johnson's 28 hp. in 1953 and went over the top with Merc's 100—has stopped. Instead of announcing still bigger rigs for 1963, makers are grooming new entries in the midpower range. Alongside them a few imports, some with intriguing features, are scrambling for beachheads on the rich American market.

Bucking all the solidly entrenched two-cycle outboards this season is a spunky new four-cycle built by Homelite, itself a famous maker of two-cycle engines. Despite traditional arguments against four-cycle designs, Homelite is betting \$5 million on a cagily re-engineered descendant of the little Crosley car engine.

This 55-hp, newcomer burns anything from white marine to premium gas, and

cruises twice as far per fuel-and-oil dollar, Homelite claims, as a two-cycle of the same rating.

In the Mercury lineup, they're filling gaps in an impressive roster with four new models. The Merc 200 is a 22-hp, twin with sass enough to plane a water skier. The 350, Kiekhaefer's huskiest twin, is said to be the lightest 35-horse outboard yet made; and the new 650, Merc's most powerful four-in-line, the lightest 65-hp, rig to date. Topping these is the new 850, an 85-hp, six-in-line designed for high thrust at low and moderate speeds.

Carried over are last year's 6-, 9.8- and 50-horse models, as well as the top-of-the-line 100-hp. Mere 1000. Buyer's options include short or long shafts and a wide choice of props in aluminum or bronze.

All Mercs of 35 hp. and up have an adjustable trim tab to compensate for torque side pull. When bronze props are used, electrolytic action in salt water would normally attack the gear case. For '63, the trim tab, a small and inexpensive replace-



West Bend: new models, more silencing

Golden Shark 300 develops 30 hp, at 4,750 rp m., is convertible to electric starting. Also new are the 20-hp, 200 and two electric starting 45s, with and without alternator.

Scott shows its new work-diesel





Boy I Scotts, uprated to 45 bp rest of the starting models (left At is the South Fig. 8 kd at 15 fg. 8 kd at 15



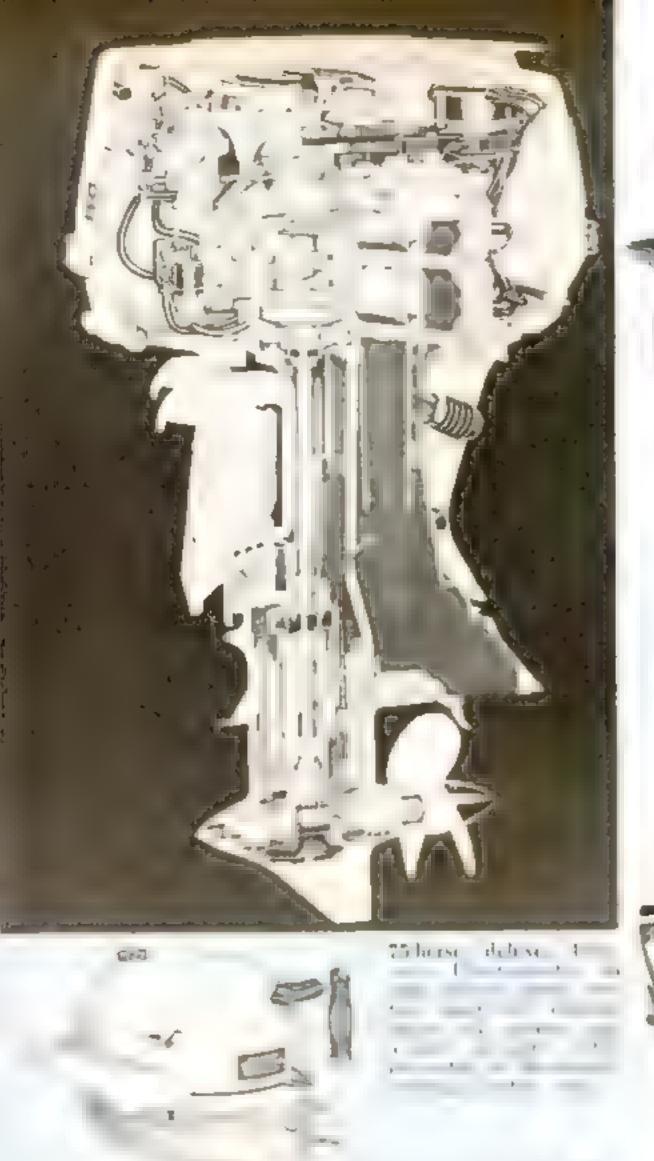
Acoustical leg chamber, shaped and lined to make noises cancel out through interference effects, is standard on three West Bend motors, optional on the 300 Low-level rewind starter, standard on 74- to 30-hp, rigs, is geared at a 6 1 ratio that makes it easier to pull Cord comes off at bottom of auxiliary shaft, so there's less tendency of the motor to tilt during starting.

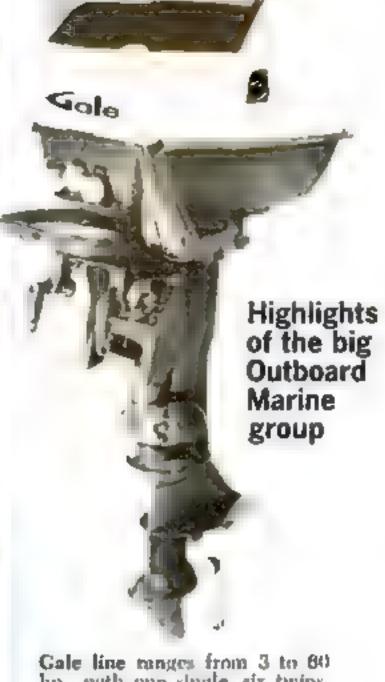
ment, is made of a "sacrificial metal" that draws electrolytic action to itself and, slowly disintegrating, saves the gear case from damage.

Johnson outboards keep their lineup of 3- to 75-horse models, but are pushing 28- and 40-hp. "convertibles" for the economy minded. These have starter ring gears on the flywheel and can be altered for electric starting with a \$90 accessory kit. A generator can also be added for about \$70.

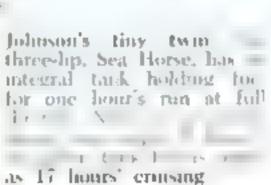
With their little three-hp, fishing motor it is now possible to use an accessory fuel pump and six-gallon tank and stretch your cruising time to 17 hours. Other Johnson improvements include chrome-plating the lower end of the crankshaft on several models (to resist rusting where it extends into the exhaust tube), an extended water jacket on the V-75, bigger oil-drain screens in several power heads to reduce fouling at idling, more stainless steel and stronger die eastings in all models.

Though not billed as a convertible, the 18-hp. Johnson can be fitted with electric starting for





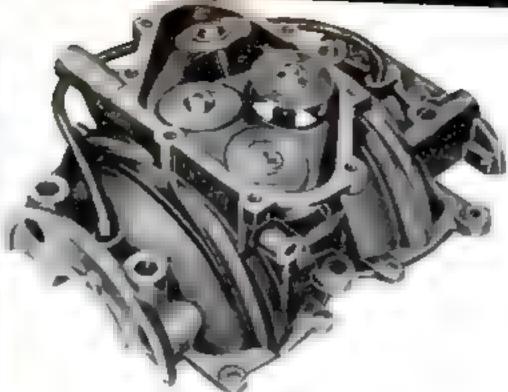
Gale line ranges from 3 to 60 hp., with one single, six twins, and a V-4 in it. Electric starting can be had on 25-hp. and larger motors, generators on the 40-hp. model and up.



Evinrude invites economy buyers who want big motors with the new 75-hp. Speedifour. It has electric starting, conventional gearshift, thermostatic cooling, and automatic choke Buyer has choice of four props.







Britain offers two outboards

One lever releases the shroud of the British Perkins 40-horse motor. Largest of five models, it has an alternator and a radio-noise suppressor as standard equipment. In this and the 30-hp, model, poppet valves opened by cams on the crankshaft control the intake, Valves have steel stems and adminimum heads, with springs on top. They never need grinding.

\$72.50. No generator is available for it. The Shark line made by West Bend has been restyled and enlarged by four new models—two electric-starting 45-hp. outboards (one with alternator and battery ignition), a 30-hp, rig that's convertible to electric starting, and a 20-horse. Also set to chug are the four-in-line 80-hp. Tiger Shark, 12-hp Silver Shark, and 78-hp. Shark. And there's a featherweight one-

lunger, too, the air-cooled 3%-hp. Shrimp. Gale Buccaneers for '63 show slimmed price tags and a fattened list of stanless-steel parts (326 in the big V-4). Prop and drive shafts are stanless in all but the smallest motor. Prices range from \$135 for the three-hp. baby to \$900 for the generator-equipped 60-hp V-4.

New from Evinrude is the 75-hp. V-4
[Continued on page 198]

Simple Bundy gladdens do-it-yourself mechanics

Made in Milan, the Bundy motors have stainless-steel drive and prop shafts, rubber suspension, insulated shrouds, intake silencers. Electric-starting model below weighs 103 pounds, puts out 30-lip. at 5,000 r p.m. The 20hp. manual-start motor weighs 70 pounds. Reed-valve boxes can be serviced or replaced in minutes (below, right). Tapped holes in the lower housing carry two spare plugs. Dual coils are interchangeable with Volkswagen's



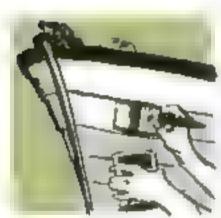


AVE a list of boat jobs you've put off, week to week, all summer? Have trouble getting your boat fully rigged in time to take advantage of the beautiful early-spring boating weekends? Ever find yourself furtively spending the Fourth of July doing some job on your boat that should have been done in April?

Me, too.

But there's something about the clear, crisp, autumn air that helps a boatman make clear, crisp decisions. My decision-of-the-month is that, while I can clearly remember all the things I wish I'd done last spring and summer, I'll do 'em now.

You'll have your own list, of course. And if you boat in southern waters, the jobs you do now will pay off all through the winter boating season too. My own "want list" includes a mixture of new equipment, new systems, and a corpentry job or two. Before December 1, I hope to have a "completed" check mark at each of these 16 items.



Painting. Here's the most important item on my fall list. Because so many people let it go until then, spring has become the big painting season. Actually, fall is a much better time.

For the reasons why, plus ideas on new paints and how they work, see "Fall Is the Time to Paint," which follows right after this article.

I NSTALLATION of mechanical steering. Every time I turn the steering wheel on my 22-foot Thompson, I'm physically moving nearly 500 pounds of motors. The twin 75-horse outboards pour out a lot of power, and the driver should have them under constant and dependable control. I've already installed single-lever throttle and shift controls, which transformed many a tricky docking job from panic to pleasure.

Act Now – Boat Earlier

Here are 16 fall jobs that'll get you launched sooner next spring—and with more fun

By Jim Roe

Now I'm after the same positive control for steering, with no fear of poorly anchored pulleys giving way at embarrassing moments.

The answer will be a mechanical steering system. There are a number on the market. My choice is the type that uses push-pull cables controlled by a rack-and-pinion drive in the wheel assembly.



This system has the advantage of being efficient from the wheel back to the motors, and efficient from the motors back to the wheel, Reason: When you turn the wheel, the input load is from the pinion to

the rack, giving great mechanical advantage. But loads coming from the motor end of the cable are transmitted from the rack to the pinion and are at a mechanical disadvantage. Still better, the Morse system I'm installing has an adjustable brake control that eliminates torque feedback.

Properly installed, this system will greatly case the task of handling high-horsepower motors, and will last for years. Improperly installed, such a system may give you so much trouble you'll leave the sea forever. Therefore, if you hire someone to do the installation job, make sure he's competent and conscientious. If you install the system yourself, be sure you can pass the same test.

Prime thing to remember when installing "flexible" push-pull cables is that they are not really flexible. They can be bent in a gradual arc, but the nearer you can come to installing them in a straight line, the happier your life together will be. Inside its flexible easing, the control cable itself is a stiff wire that must transfer motion both under tension and compression. If it's ever kinked, it's kaput.

There are only a few rules to follow in the use of push-pull cables (whether for steering or throttle/shift control), but each

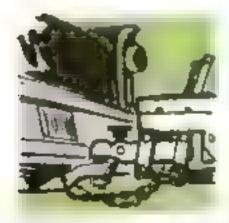
is vitally important:

First: Select the shortest and easiest route from the control head to the engine. This should be one that avoids all unnecessary bends and permits no tight bends at all. The easier and fewer the bends, the better the cable will work.

Second: Use the shortest cable length practical. An extra S bend at one end to use up extra cable can cause a lot of trouble.

Third: Make sure the cable connections are not crowded or cramped. At the engine end, be particularly careful that the cables don't stick out into areas of the motor well where they can get stepped on or otherwise damaged.

Fourth: Make sure the terminals at both ends are properly positioned and secured so that they can't work loose in service.



R USTPROOF trailer brakes. Many an experienced sailor survives the rigors of the sea only to run into trouble ashore. One item on my fall "to do" list

was born in a puff of blue smoke on Labor Day. Only the smoke wasn't caused by a magician—it was coming from the four wheel assemblies on my tandem-axle trailer, and was about to turn my boat into a junior edition of the Morro Castle.

Some detective work finally showed what

had happened. The linkages of the surgeaction control unit for the trailer's hydraulic brakes had rusted into rigidity. The cure was penetrating oil and a wrecking bar.

The prevention? Much easier. A little penetrating oil now and then, and a liberal application of anticorrosion oil before the trailer goes into hibernation.



Improving the radio. In 1963, Roeboat's radiotele-phone will be three ways better: First, I'm installing radio noise-suppression kits. Anyone with a depth

sounder, RDF, or radiotelephone probably has had interference from the engine's ignition. As more electronic equipment goes

on outboards, the problem grows.

On my boat, the 65-watt Bendix radiotelephone suffers, too. I usually have to turn off the motors for satisfactory communication with lock tenders, marine-phone operators, other boats, or shore stations. So this fall I'm getting noise-suppression kits from Outboard Marine.

These suppression kits include shielded leads from the spark plugs to the distributor, a distributor-shielding cover, a coil shield, generator-output suppressor, voltage-regulator capacitor, and a radio-hue filter. The radio leads are connected to the output terminals on the radio hne-filter assembly.



A WHIP antenna.

Another big radiotelephone problem has been caused by an antenna unsuited for any water more exciting than a backyard swimming pool.

Reason: The upper, extending portion consists of a metal rod. Now, guess what happens to that metal rod sticking up into the air when the boat goes through rough water at speed.

You're right. It bends.

For two seasons I've had to lower the antenna to trailing position whenever I wanted Roeboat to move at anything faster than breast-stroke speed. Besides, I might want to send an important message to the

Coast Guard some day when the water is rough. For times like that I need an antenna that can take it—and send it.

So I'll bid farewell to the old antenna I never should have installed anyway, and replace it with a whip antenna; one of the new Shakespeare fiber-glass models. But this time, I'm wary. I'll test it first. Unless it bends like a fly rod and seems to enjoy it, I'll keep looking.



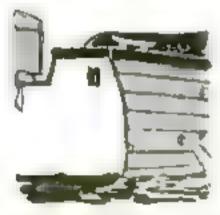
A HINGED radio mount. This carpentry job will make it possible for the radiotelephone (or any other instrument) to be outside in the cockpit, handy, all

during a day of boating. Let when the time comes to button up the boat and leave her at her moorings unattended, the radio can quickly be shifted to the cabin interior where it will be behind a locked door.

To make the radiotelephone do its disappearing act, I'll simply cut out the section of the bulkhead to which it is attached, then attach this section back to the main bulkhead with a stout hinge. Pulled into its normal position and firmly latched, the radio is outside, in the cockpit.

Yet it can be shifted inside the cabin by releasing the catches and swinging it in, without detaching any power or antenna leads. A new mahogany panel then seals

up the opening in the bulkhead.



An AUTOMATIC bilge pump. Ever get the feeling. during a midweek siege of heavy rain, that your boat may be getting a little soggy? I have, but

my two bilge pumps always wait till I get to my destination to do anything about water in the bilge.

So I'll install a simple air-bell-principle automatic switch on one of our present pumps. This will actuate the pump any time water rises above a certain level in the bilge and turn the pump off again when it has lowered the level. The air bell itself I'll mount in the bilge. It sends its pressure-borne message to the switch

through plastic tubing, so there's no need for electrical wiring in the bilge.

S PARE parts. It's not difficult to spend half of a good summer boating day searching for a 35-cent part you must have to get some piece of equipment working again. Prize examples, of course, are fuses, gasket material for bilge pumps, an extra

impeller, and spark

plugs.

It's much less frustrating to spend some good cold, rainy nonboating fall hours filling out your shopping list for these pesky parts. Make sure your

list includes, besides the things I've already mentioned: spare bulbs, screws and bolts of various sizes, clamps, hull-repair materials sufficient for an emergency job, electrical wire, and a spare propeller.



Dights, A spotlight is a fine and businesslike - appearing thing on a boat. And completely necessary, too, But for a no-hands method of

illuminating a string of wandering channel markers, I'm convinced docking lights are the real answer.

They light up a broad band rather than a small area, and do it while allowing you to use both hands for steering and throttle control. Since the port and starboard lights are each on separate switches, you can follow the channel markers on the starboard side with minimum danger of illegally blinding oncoming boats on the other side of the channel.

On a rough night, docking lights can light up the oncoming waves to give the boat operator a better idea of their size and spacing. On open water, lights provide a good way to watch for floating debris where such hazards are expected.

All this, plus the advantages they offer in the area for which they are named—docking—make docking lights a high-priority investment, in my opinion. Not too difficult to install, these lights come with templates and adequate instructions for mounting.



M CORING-LINE snubbers. Last year, Roeboat was moored in a slip in Chicago's Burnham Harbor. This is a beautiful harbor. But when the wind is

out of the south, a surge from Lake Michigan enters the mouth, hitting moored boats broadside. It is a heart-stopping, line-part-

ing, cleat-pulling force.

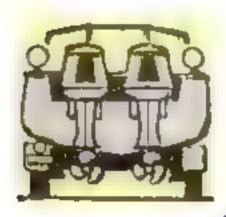
One solution is to absorb some of the shock gradually, so the full, sharp impact never reaches the moored boat. There are several styles of snubbers that will accomplish this. Some are rubber, with a loop in each end, and are tied into the mooring line. Another rubber one, in the form of twisted line, can actually be spliced right into the mooring line.

I plan to use a metal spring-style snubber. I'll attach it to the cleats and bollards on the clock by loops of chain, then run strong, shock-absorbing nylon line to the boat itself. If the weather is especially rough, I'll run two lines to both the bow and stern from the weather side, attached to different cleats, bitts, or eyes on the boat. If these double lines are carefully rigged so that they become taut at the same time, it will help distribute the shock load.



CREASE the wheel bearings on the trailer. This is so elementary it shouldn't need mentioning—except that hardly anybody does it. Most of us wait till we have a

specific place to go in the spring, then sweet-talk our favorite garageman into squeezing in the job early on the Saturday morning we want to take off.



TRAILER hights.

If you are a person who obeys the maximum speed limits for cars when rolling free or towing a trailer, it doesn't take you long to discover

[Continued on page 194]

Fall Is the



Post boatmen don't get the itch to point their boats until the warm weather of spring has also given them the itch to get the boat into the water. The result, too often, is that both boat and owner get short-changed: the owner, because he's sanding and painting on the good-weather weekends he'd like to be affoat; the boat, because most of us are too impatient in the spring to take the time necessary for a good paint job.

There's one simple solution to both problems: Paint your boat now, in the fall. Over most of the country, the clear, dry fall days offer ideal finishing conditions. Take advantage of them to do the thorough surface preparation that is the key to a good marine paint job. And if you do the base-coat painting jobs this fall, too, the finish coats can be handled in a relatively

short time prior to launching.

Time was when you'd sand, scrape, calk, and then pick up a can of "boat paint"—and that would be that. Now you have the problem of choosing among many boat finishes. In addition to the old standard bases—natural oils, alkyds, and phenolics—there are the newcomers: vinyl, epoxy, polyurethane, acrylic, and silicone polymers.

To determine which paint is best for your purposes, consult the accompanying chart.

Before you paint. No matter what paint you use, be certain your boat is really dry and clean before you paint. Best bet is to wash down the hull immediately after it is

Time to Paint a Boat

hauled, and at the same time thoroughly clean the bilge. Take up the floorboards in a wooden boat, no matter how solidly they are fastened down. With a garden hose and a brush, dislodge all the dirt in the cracks and crevices along the keel. Then let the hull air-dry for 30 days, or until you are certain the dampness is out.

First step then is to slosh a preservative solution of copper napthanate deep into all the crevices inside the hull. This solution may be used as a priming coat on bare wood, and provides protection to hard-to-reach spots that will not receive coverings of paint or varnish. (Many boat manufacturers now pump their partly completed hulls full of this solution, during one stage of manufacture, providing protection right from the start.)

Wood surfaces thus treated will repel wood-decaying fungi and wood-destroying insects, including termites and teredos. The solution can be brushed, sprayed or put on by dipping. Main point is to apply two liberal coats. If you use the solution as a dip, allow three minutes immersion per inch of wood thickness.

Now, too, is the time to apply a sealer to all the widening cracks you've been noticing all summer, whether below or above the water-line. In particular, look for small cracks along the stem. Let the sealer dry at least 24 hours before covering with paint or varnish.

Power sanders make short work of what used to be a

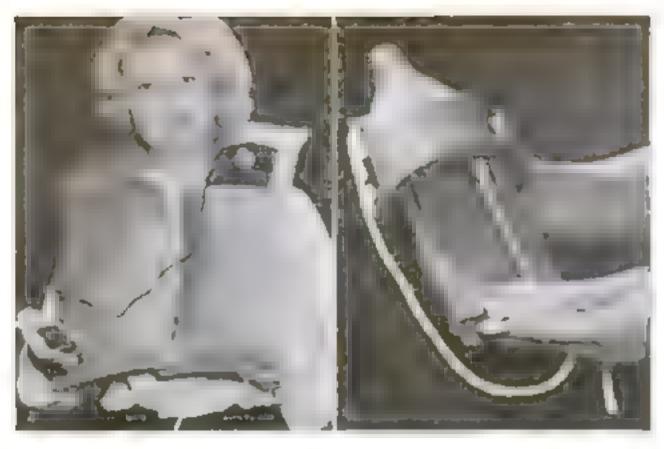
[Continued on page 196]

	Choice of paint according to type of beel material	Approximate quantity needed according to size of boat			
	WOOD	16"	181 to 211	21 to 24'	24" to 32"
±.	1. Paste wood filler (mahogany) 2 Phenol C varnish first coat	1 p1	2 pt.	3 pt.	4 pt.
WORK	3. Phenol c varnish second coat	11/2 41.	3 qt.	41/2 qt	6 qt
E 3	Brushing thinner	1 qt	2 qt	3 qt	4 qt
21	1 Epoxy undercoater	Lqt	2 qt	3 qt	4 qt
TOPSIDE ENAMEL	 Epoxy white or color—first cost } Epoxy white or color—second cost } 	S dr	4 qt.	6 qt.	8 qt.
20	Epazy thinner	1 qt	2 qt	3 qt	4 qt
BOTTOM	1. Vinyl red undercoater 2 Vinyl bottom paint first coat)	1 qt.	2 qt.	3 qt.	4 qt.
90	3 Vinyl bottom paint -second coat §	1 qt	2 qt	3 qt	4 qt
2 × 2	Viny) Ih-naer	1 qt	2 qt	3 qt	4 qt.
	STEEL	181	78' to 21'	211 to 241	24' to 32'
100 and 1	1 Vinyl metal primer 2. Vinyl red undercoater—first coat;	2 qt	4 qt	6 qt	8 qt
PSIO	3. Vinyl red undercoater-acc. coat(2 qt	4 qt.	6 q1	8 qt
DEN I	4. Alkyd ename! Vinyl thinner Broshing thinner §	2 qt. 1 qt	4 qL 2 qt	6 qt. 3 qt.	B qt. 4 qt.
· ·	1 Viny) metal primer	1 qt	2 q1	3 qt	4 qt
BOTTO	 Vinyl red undercoater—first coati Vinyl red undercoater sec coats 	1 qt.	2 qt	3 qt	4 qt.
A5 8	4 V my bottom paint first coat 1 5. V myl bottom paint second coat (1 qL	2 qt	3 qt	4 qt
<≖	Vigyl thinner	2 q1	4 qt	6 q1	8 qt
	ALUMINUM	16'	18' to 21'	21' to 24'	24' to 32'
19	1 Acid etch wash	1 pt	2 pt.	3 pt.	4 pt.
ENAM	2 Epoxy enamel—first coat 3. Epoxy enamel second coat	2 pt.	4 pt	6 pt	8 pt.
20	Eposy themser	1 pt	2 pt	3 pt.	4 pl.
. 3	1 Viny) metal primer	1 01	2 qt	3 qt. 3 qt	4 qt 4 qt
SE.	3 Specia aluminum antifou ing — 1	1 qL	2 ql	2 44	4 47
SAC BOTTO	4 Spec a. aluminum ant-fouling second coat	1 q1.	2 qt	3 qt	4 qt
-= 1	Vinyl Ihidaer	1 qt.	2 qt	3 qt.	4 qt.
	FIBER-OLASS	16'	18: to 21'	211 to 241	24 to 32'
	1 Wash with brushing thinner 2 Epoxy enamel first coat	1 qt.	2 qt	d qt	4 qt.
ENAM	3. Epoxy enamel- second coat Epoxy thinner	2 pt. 1 pt.	4 pt. 2 pt.	6 pt. 3 pt.	8 pt. 4 pt.
		1 -1	0.51	7.01	A
ING BOTTOM	1 Wash with brushing thinner 2. Vinyl red undercoater	1 qt.	2 qt. 2 qt.	3 qt. 3 qt.	4 qt.
200	Y nyl bottom paint—first coat { Vinyl bottom paint—second coat {	1 qt	2 qt.	3 qt.	4 qt.
55	Vinyl Ibinner	1 qt.	2 qt.	3 qt.	4 qt.

For additional information on painting techniques and supplies, a handy booklet, "The Finishing Touch," can be obtained at paint dealers or by sending 25 cents to Pettit Paint Co., Inc., 507 Main St., Belleville, N. J.

what's new BOATING

Rescue Light Flashes On by Itself



Take a spill over the side at night and this distress light flashes on to mark your location. Pinned to clothing or a life jacket, it's turned on automatically when a special battery hits the water. The light is also available as a marker buoy (right) and in a swimmer's model that can be turned on as needed by pulling a cord. Prices start at \$3.45. Resistance Products Co., 914 S. 13th St., Harrisburg, Pa.

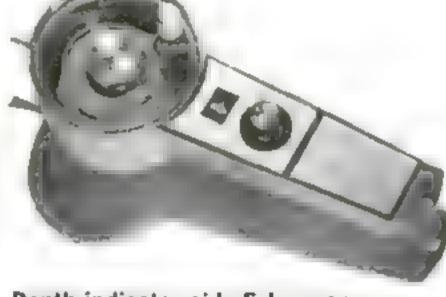




Wind-measuring instrument for boaters

For mounting on a mast or rooftop, this remote-reading anemometer is sensitive enough to measure wind velocities of less than two m.p.h. Calibrated in two scales, it reads from 0-35 and 0-100 m.p.h. Price is \$60. A hand-held model, with 0 to 35 m.p.h. scale only, sells for \$28.50. R. A Smerl, \$13 South Fairfax St., Alexandria, V.a.

▶▶▶A flip of the switch changes a new dual-purpose meter from a speedometer to a tachometer. The transistorized unit picks up speed readings electronically from a sensing element; engine r.p.m. from a single sparkplug connection. Price is \$56.50. Semeo. 1400 Riverside Drive, Ft. Worth, Tex.



Depth indicator aids fisherman

The Fish-O-Therm, designed to end guesswork in seeking proper depths for fish, is a battery-operated temperature and depth indicator. The fisherman lowers a sensing element on a wire until it indicates a preset temperature. Then he reels it in and drops his bait to the same level, \$29.95. Manneapolis-Honeywell Co., Minneapolis.



Bearing seals protect trailers

You can protect your trailer wheel bearings from water damage with shields that slip over the hubs. They cost \$5.95 a pair. Prime Industries, 5411 Jefferson Bldg., Los Angeles.

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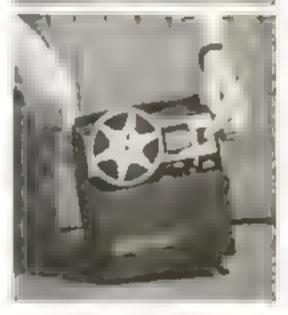


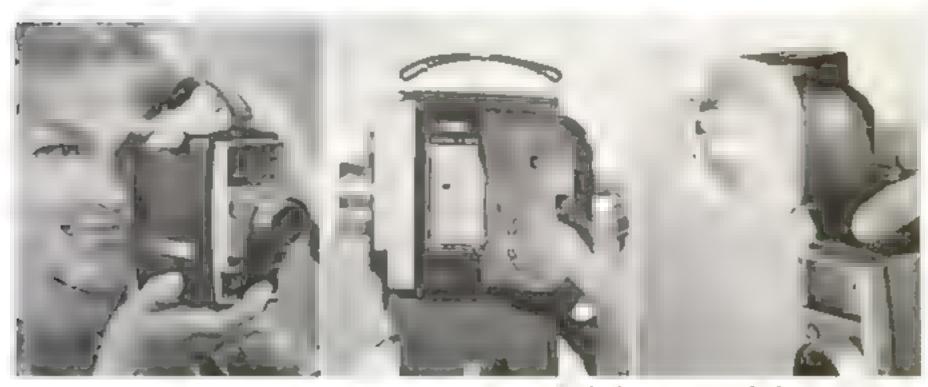
Automatic Projector Does It All—You Just Sit

Drop a reel of film onto the supply spindle, switch the projector on, and insert the film into the gate. From then on this Kodak projector takes over. It automatically feeds the film onto the take-up reel. When the end of the film is reached, the projector turns the projection lamp off, turns the room lights on, rewards the film, and then shuts its own motor off.

The automatic rewind can be activated manually at any time by a rewind trip lever on the supply head. The projector is sprocketless, has no reel arms, but has a capacity of 200 feet of film. It rewinds a full 200-foot roll in about 20 seconds. The unit is a compact, quiet-operating machine housed in a special sound-absorbing ease. It weighs only 11% pounds and sells for less than \$110. Eastman Kodak Co., Rochester, N.Y. is the manufacturer.





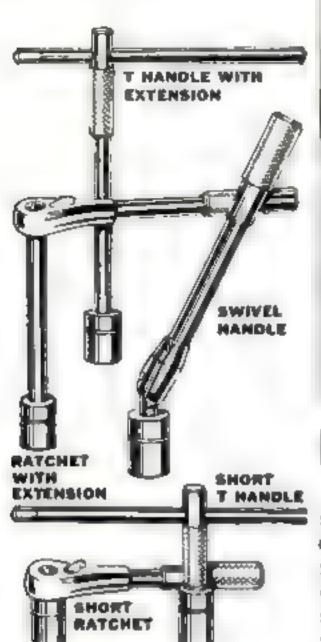


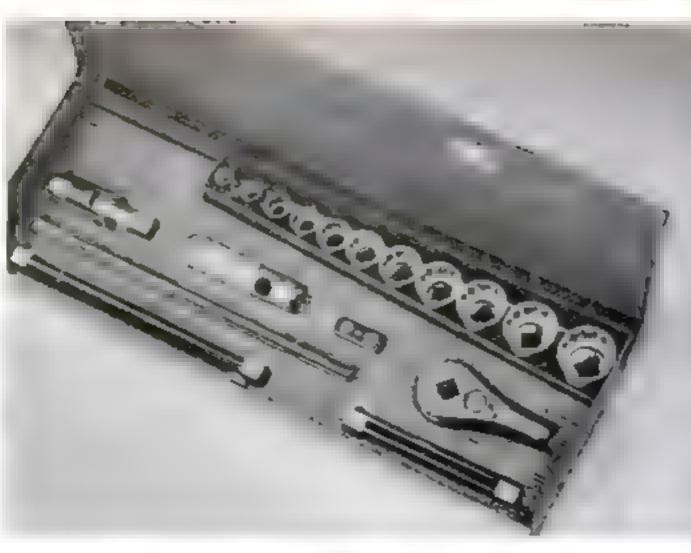
And new movie camera is automatic, too

The automatic movie camera above has a battery-powered motor drive and a unique user-loaded cassette for 8mm roll film. Exposure control is automatic and focusing unnecessary. A large exposure-release bar gives single-frame control for animation. The Kodak Electric 8 model sells for about \$100.

A compact movie light, the 650-watt Kodak Sun Gun (under \$22), attaches to the top plate of the Electric 8 and other 8mm cameras with threaded sockets.

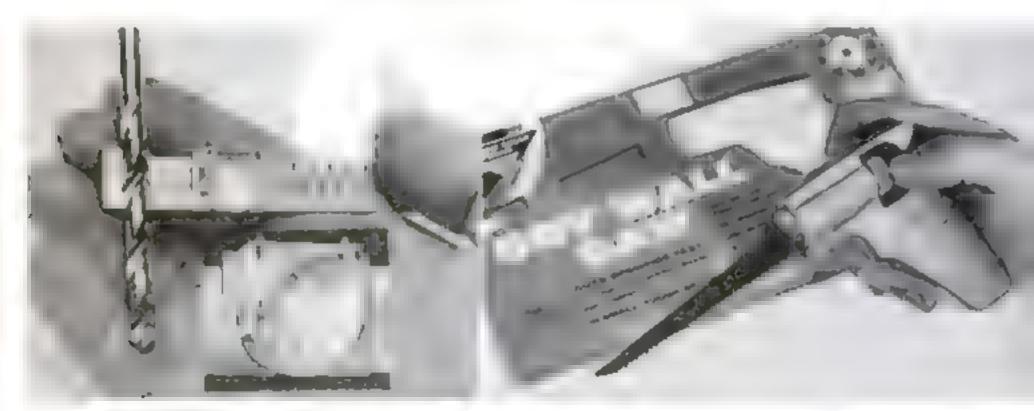






Make-Your-Own-Wrench Kit

Now you can tailor-make just the right socket wrench in seconds. Seven basic driver parts combine to give hundreds of different wrench combinations. With them, you can make ratchet, T-handle, swivel, extension, and other types of wrench drives. The X"-drive set includes 11 sockets from X" to X". It sells for \$21.90. A \(\frac{1}{2}\)-drive set sells for \$30. J. H. Williams & Co., 400 Vulcan St., Buffalo, N.Y.

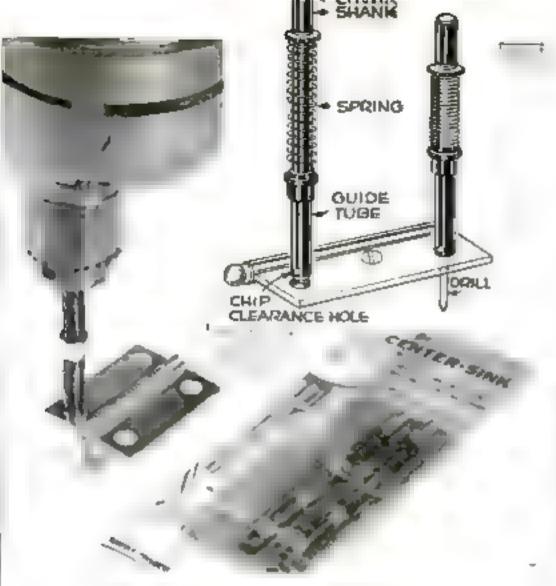


Handy slide micrometer

On-the-spot measurements of drill bits and other objects up to 1" are possible with this pocket-size slide micrometer. You simply insert the object in the slide and read the number shown in the magnified window. The thinness of the Micro-Slide makes it ideal for tight places. \$2 50. Amtronix, Inc., Box 44, Chula Vista, Cahf.

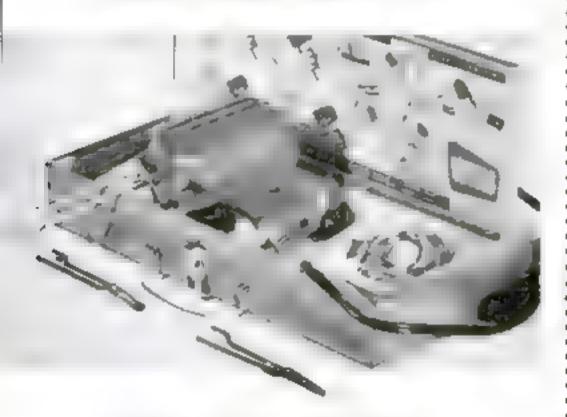
Keyhole saw for cutting drywall

Designed especially for plasterboard, this keyhole saw rapidly cuts openings for outlet boxes, switches, and similar work. The chuck permits locking the blade in eight positions for sawing at any angle. With the pointed blade, you can easily punch starter holes in drywall. \$2.75. The Millers Falls Co., Greenfield, Mass.



Drill bit centers screwholes

Exact centering of screwholes in hinges and other countersunk hardware is possible with this special bit. A spring-loaded collar fits in the countersunk recess to guide the bit and retracts as the bit drives in. Three sizes handle Nos. 5, 7, and 9 screws in X" to %" lengths. Price is \$1.50 each from Norfolk Products, Norfolk, Conn.



Soldering kit for special jobs

Three interchangeable tips let you use this soldering gun for many extra jobs around the house. With a cutting tip, you can soften and remove hardened putty and cut tile and plastic. Change to a flatiron tip and you can remove dents from furniture or seal plastic packages, \$9.95. Wen Products, 5804 Northwest Highway, Chicago.



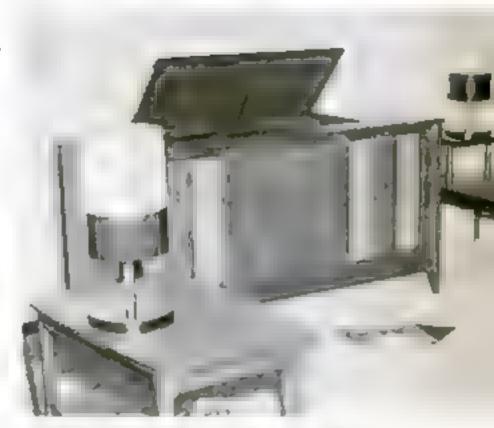


Table lamps? No, stereo speakers

These hi-fi stereo satellite speakers, housed in circular enclosures, look like table lamps. Each uses a six-inch midrange speaker and horn tweeter facing upward. Individual diffusing cones spread the sound in a complete circle. The satellites are designed for use in pairs, in conjunction with a single woofer, which is usually located in the record-player cabinet. With their unobtrusive design, you can place them anywhere in a room to obtain the best stereo effect. They are made by Electrohome of Canada, Kitchener, Ont. Price, about \$50.

Car radio receives TV sound

Now you can hear TV sound on your car radio, The AudioMonitor converts TV-UHF frequencies for reception without impairing normal AM use of the radio. Under average conditions, TV sound comes in fine within a 40-mile radius, About \$125. Mobil-sound Corp., Box 951, Santa Monica, Calif.



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Now: Electroplating in Your Mechanics and Handicraft Own Shop SECTION

By John Burroughs

A bench-top rig you can make puts shiny, lasting metallic finishes on tools and ornaments

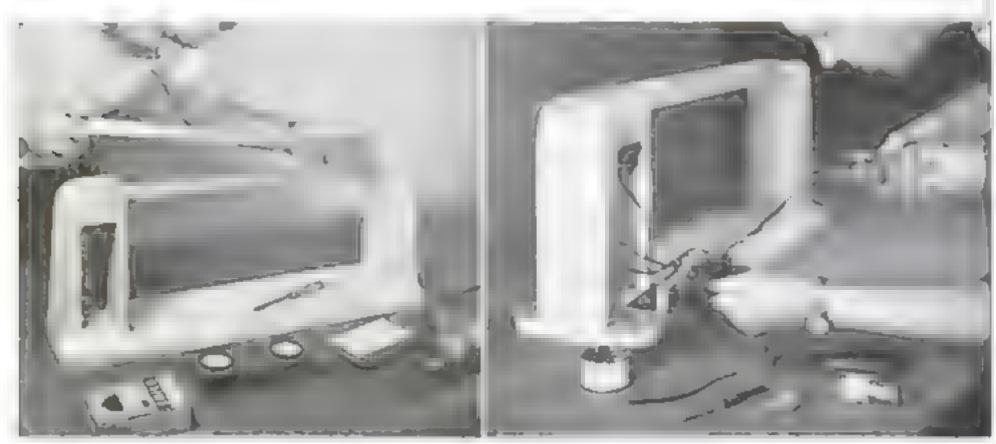
SIX-VOLT battery charger, a couple of glass fish tanks from the dime store, and a plywood rack to hold two aluminum electrodes will put you in business to explore a fascinating field of metalwork.

Electroplating, the chemical process in which one metal is transferred directly to another, becomes a simple home-shop operation with the setup shown here. With it,

you can put gleaming copper, nickel, or zine finishes on any iron or steel object that you can dunk in the tanks.

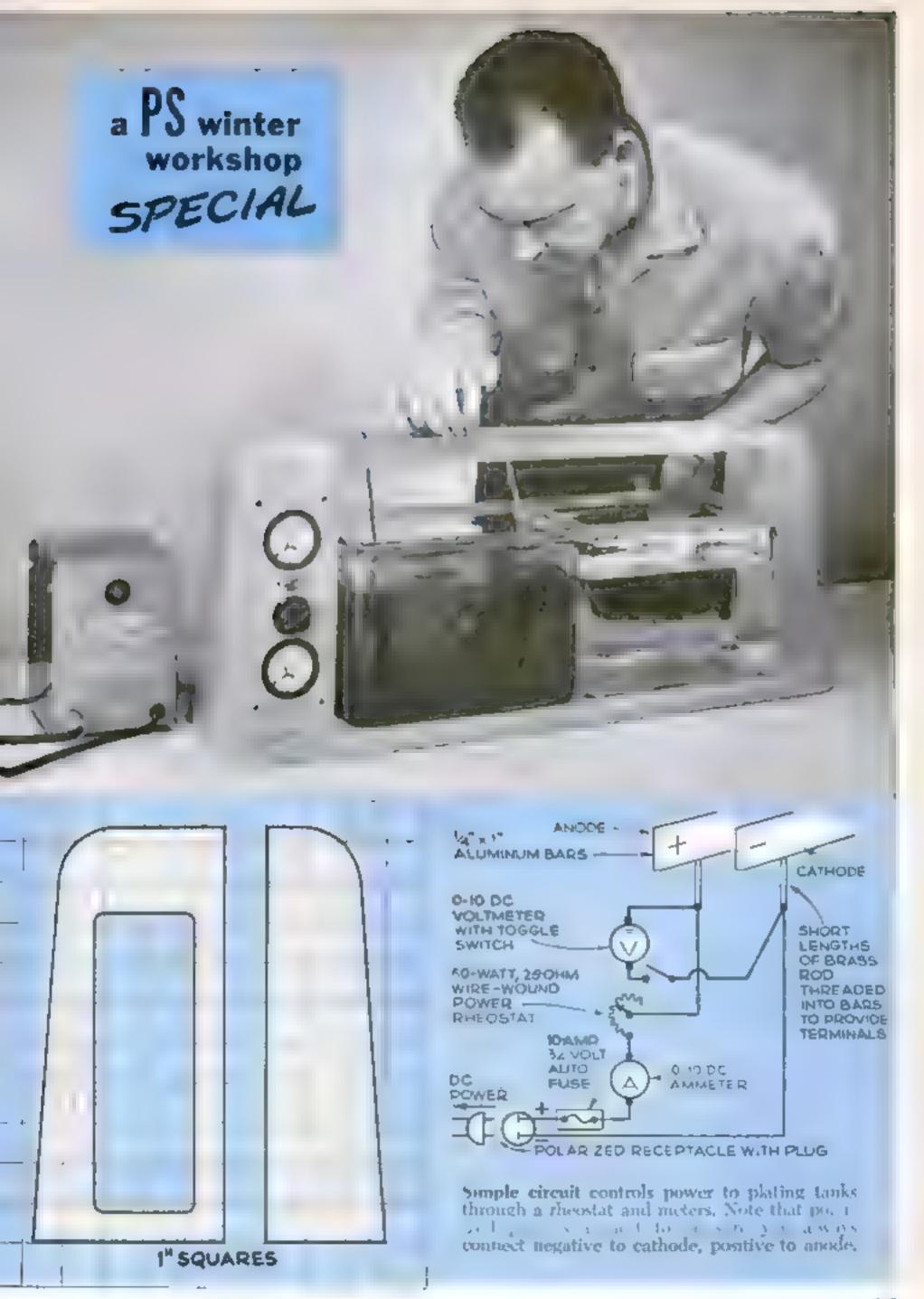
You can rustproof tools, brighten up hardware, even metallize nonmetallic objects like leather, leaves, shells, pine cones, or flowers to make unusual decorations and jewelry. You can electro-etch and inlay designs in copper and brass craftwork. You'll also be able to do electroforming, such as making permanent copper molds for typemetal castings.

How electroplating works. When you pass an electric current through certain chemical solutions, particles from one electrode (the anode) are attracted to the other elec-



Homemade plating rack, a slick-looking rig, actually is built up easily with five layers of A" plywood making each end support. Aluminum electrode bars slip into notches at top.

Electrical controls mount on a plate and fit into a cutout in one end support. Fuse and receptacle go in back on a similar plate. Drill holes in the plate to vent rheostat heat.



How to put a gleaming nickel plate on an old steel tool



Age-darkened hammer head it let is first politished on a flexible disk of the orthogonal desired cloth (center). It's then even a more of the suspended from the plating rick's member in

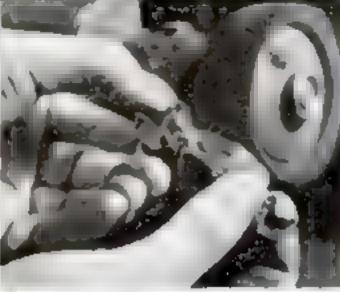
a bok of lit a fricately order atomic order to a factor of the first order to a factor of the first of the factor of the first of the factor o



Nickel flash a very thu makel diposit is put in most by saspine ing the land from the chief bur i across sality noter burt two raportes (left). Any balances that form should

be brusied my the bedieth transferred to clink of a per so that ries and great a si studial cope to be the energy and mornior for the find partized accel-







After copper plating, the head is put back in the messel link for the final track plate. After about helf or hour at takes on a smooth, salverswhite look (left), indicating a satisfact is

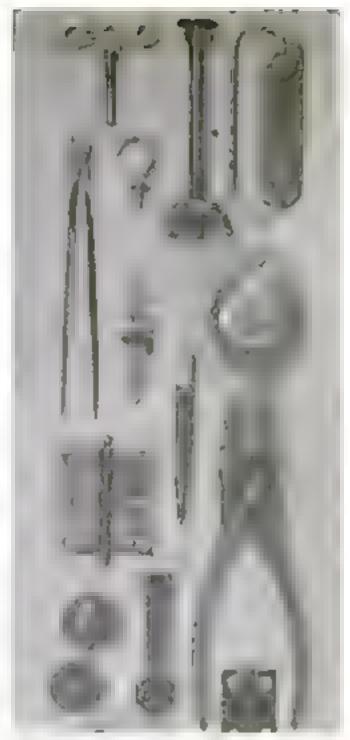
with the first ten britted bright with with a compound on a cloth which contex. Add a fresh him de and see what a difference the tough, shiny new first makes

trode (the cathode). So you make the cathode the object you want to plate and the anode a chunk of the metal that you want to do the plating. As current flows, the anode metal slowly dissolves in the solution and becomes free metal ions that are attracted to the object that's to be plated. The ions gradually collect on the object and become crystals of pure metal. Eventually, the crystals build up a layer of solid metal, and the object is permanently plated.

In the setup shown here, two aluminum bars are used to carry current across the tops of the plating tanks. One represents the anode and the other the cathode. Objects to be plated and the plating metals are samply hung from the bars on wire hooks. There are no electrical connections to make, and the suspended objects can be quickly switched from one tank to another.

Plating solutions. The chemical solution you use depends on the kind of metal that will form the plate. The solution must contain free ions of the plating metal in order to start the chemical process going. A copperplating solution, for instance, must contain some free copper ions to begin with. As these ions are used up, the copper anode is etched away to provide a constant supply of new ones.

There are two basic types of solutions, acid and alkaline. Acid baths for copper, nickel, and zinc plating are the simplest and safest to use. They're mixed with harmless metal salts, generally sulfates or chlorides, to provide the free metal ions. Mixing proportions aren't critical, and the baths can be used at room temperature over a wide variation in current.



Ordinary household objects take on a glattering shren-as well as lasting protection against corresion—when you plate them this way.

Two offbeat plating tricks produce eye-catching decorations

Two-tone plating is possible this way. Here, the design in a copper tray was mckel-plated by coating everything but the design with resist a compound that prevents plating. The etching and plating solutions were then poured right into the design without using a tank.

Nonmetallic objects, such as these leaves, can also be plated. The secret is to coat them first with an electrically conductive paint to carry the plating current. You can make such a paint yourself by mixing grease-free bronze powder with a little thinned spar varnish





PLATINGESOLUTIONS

Copper

28 oz. copper sulfate
4 fl. oz. sulfurie acid
(28% battery acid)
1/4 tsp. white Karo syrup
1 gal. water

Use at room temperature with tank current of 10 to 30 amps per square foot at 1-4 volts. Buy copper suifate at garden shops, drugstores, chemical houses. Many gas stations stock 28% sulfuric acid. Use sheet-copper anodes, Flash steel objects in a nickel bath before copper-plating in the acid copper solution above. Agitate and turn work.

Nickel

32 oz. nickel sulfate 6 oz. nickel chloride 4 oz. borie acid 1 gal, water

Use at room temperature with tank current of 10 to 20 amps per square foot at 1 to 2 volts. You can hay nickel salts and a pure nickel anode from a platers' supply house or from a commercial plater. Drugstores sell boric acid, which should be dissolved in a little hot water before it's added to the solution. Avoid contaminating nickel solution with zinc.

Zinc

32 oz. zinc sulfate
3 oz. ammonium
chloride
(sol ammoniae)
1½ oz. sodium acetate
½ tsp. white Karo
syrup
1 gal, water

Use at room temperature with tank current of 10 to 30 amps per square foot at 1 to 3 volts. You can buy zine sulfate, sodium acetate, and ammonium chloride from a pharmacist. Use zine anodes—old printer's line blocks are generally zinc. Agitate and turn work.

Some metals, however, can't be plated from simple acid solutions. It's necessary to use alkaline solutions to plate with brass, silver, gold, or rhodium. Alkaline solutions are required for plating zinc die castings.

Since alkaline solutions usually contain potassium cyanide or sodium cyanide, both deadly poisons, alkaline solutions must be cautiously handled in a well-ventilated shop area. If a cyanide is accidentally mixed with acid, hydrocyanic-acid gas, instantly

lethal, is generated.

Acid solutions are therefore best for home-shop plating and will handle most of the finishes that you're likely to want. The accompanying table tells you how to mix the three most common—for copper, nickel, and zinc. The chemicals listed, as well as anode metals and other equipment, are available from plating-supply houses. (One good source is Ramyr Mfg. Co., 1779 N. Main St., Los Angeles.)

Freshly mixed solutions, especially for nickel, often give irregular results when first used. Plating a few chunks of scrap metal will break in a new batch. You can mix and store solutions right in the tanks.

Building your plating rack. This is simply a wood base large enough to take two fish tanks with uprights at the ends to support the aluminum bars. The uprights are built-up sandwiches of five layers of \$" plywood, jigsawed to the profiles shown. The two

current-carrying bars are %"-by-1" hardware-store aluminum, notched into the tops

of the uprights.

The fish tanks used here are the 1%-gallon rectangular type sold in dame stores for about \$1.80. Other sizes and types of tanks are also available from lab-equipment supply houses. Adjust the length and height of the rack to take whatever size tanks you buy. The alumnum bars should run about 2%" above the tanks.

The power supply. The thickness of plate you get depends on the amount of electricity that flows to each point on the cathode. A plater figures tank currents in terms of "current density," expressed in amps per square foot of cathode area.

Don't let this throw you when you find some plating jobs calling for 20 to 30 amps per square foot. Most of the objects you plate will have a surface area of only a few

square inches.

An ordinary six-volt auto-battery charger which delivers about six amps, is thus a slick power supply for home plating. The selenium-rectifier type shown cost about \$15. In a pinch, you could also use a regular car battery and recharge it periodically. Or you could buy a used lab-type plating rectifier. A TV repairman's DC power supply is ideal.

You'll need some electrical controls for

[Continued on page 228]

5 Good Tips for the Home Shop

By R. J. DeCristoforo

Make your plane a jointer for small pieces of softwood. Cut a wide rabbet in a wood strip. Clamp it to the plane so the rabbet's shoulder sits on the bed and struddles the blade. Limit cuts to 1/32". To compensate for stock removal, tape on cardboard.





To hand-form a half-lap joint, clamp the parts together and remove the hulk of the material with a bit. The joint makes an accurate centerline to use as a drilling guide.



Stagger the nails when you're nailing close to the edge of a board, and drive them in at an angle. This will strengthen the joint and cut down the chances of splitting the wood.



When countersinking wood screws, speed up the job with a homemade punch—a length of drill rod beveled to match the bevel of the screwhead. For hardwood, point the bevel; for softwood, leave a small flat. Rod diameter should equal diameter of the screwhead.



Angle blocks, cut from scrap lumber, make accurate gauges for table-saw settings you frequently use. Usually, the graduations on a saw dial are so course that accurate settings are impossible. With a block of the desired angle, it's easy to set the full of the blade accurately.





Tool holder protects fingers

I was always banging a finger or dropping my punch until I made this handy tool holder. Now I can simply lock my punch, or a chisel or similar tool, in the 1" hole in the head. The hex-stock handle provides a good hand grip and also lets me use a wrench to tighten a tool in the 7"-long holder.—Norman Levy, NYC.

Math tip for measuring oversize diameters

There are times when I need to measure diameters that are larger than my vernier calipers will handle. I've found that I can extend their use by following this formula:

$$R = \frac{a^2 + t^2}{2t}$$

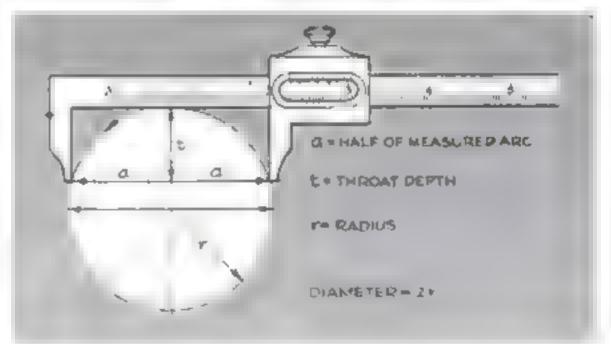
The "t" is the calipers' depth of throat,

To insure getting accurate measurements, I always take care that all three bearing points of the calipers are

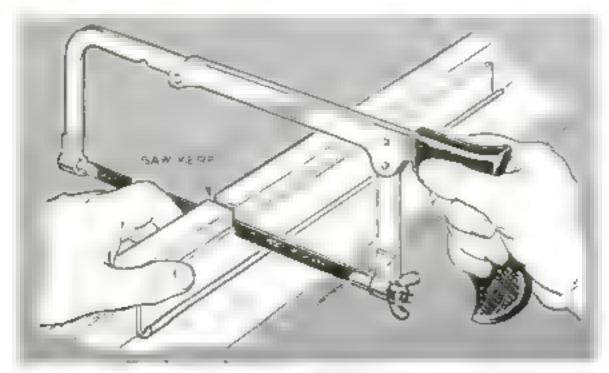


Crown on sander holds belt in place

Have trouble keeping the belt on your sander? Stretch a 1"-wide rubber band cut from an inner tube over each drum. This increases the circumference at center so the surface speed is greater at this point and tends to hold the belt there. For a permanent installation, fasten the bands with rubber cement.—H. J. Gerber, Menomonie, Wis.



in equal contact with the stock I'm measuring.—Otto K. Grade, Springdale, Conn.



Backing up metal molding makes sawing easier

Thin metal molding tends to bend under a saw, cutting raggedly. Lacking a miter box, I made an L frame of two boards. In the upright, I sawed a kerf at right angles to its length. This backboard gives rigidity, insuring smooth, clean edges. There's less wear on the hacksaw blade, too.—Michael Ligocki, Gary, Ind.



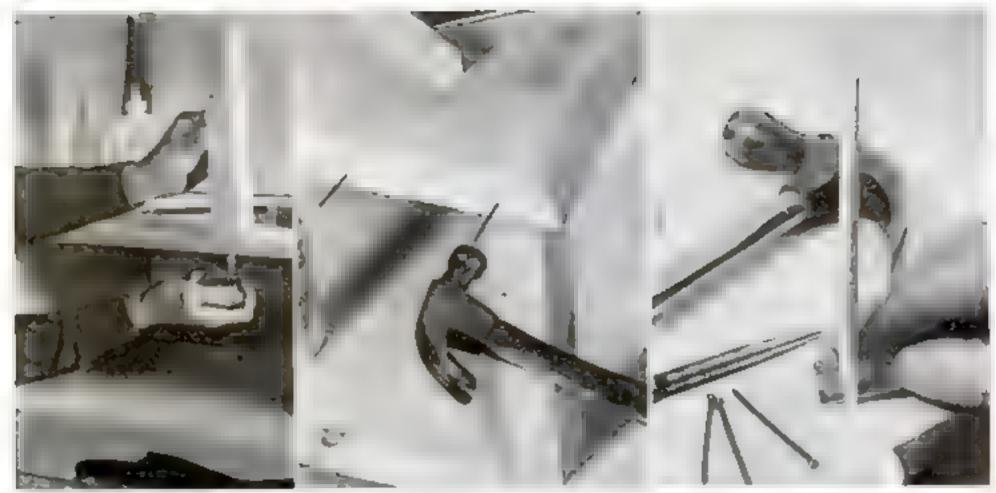
You're always ready to put on a show with this quick-change

Projector End Table

OLL the table forward on halden casters, drop two little doors, and capit your slides at the flick of a switch. Convenant? Yes, indeed, You'll get twice the fun from your color slides. Showing them will be no trouble at all

Designed to look like an Early American step table, this project takes advantage of economical, easy-to-work pine. All joints are simple butt joints except the corner-





A single screw holds the corner post at the bottom. At top, nail and glue the post to the upper piece. Popular "white" glue is one of the most convenient adhesives to use for this job.

Ogee molding, for sale in most lumberyards, forms a neat, traditionally styled edge around both the tops. Use the nailset-and-peg technique shown at right to cover the nailheads.

Finishing nails set rather deeply and white glue fasten all parts. For a smooth surface, glue tiny plug in nail hole and cut with razor blade. Afterwards, sand the stub smooth.

mitered moldings. If you wish to avoid edge-joining narrow boards, you can use preglued Widewood planks, available in wide widths at many lumberyards.

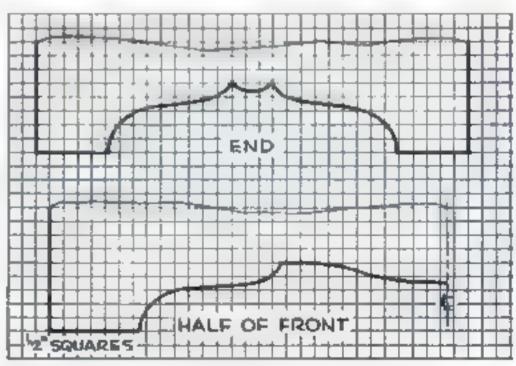
Gliding doors. The two lower doors slide on easily made concealed tracks. Or you can buy ready-made wood or aluminum tracks at most lumberyards. The two drop-down doors that hide the projector swing on the easiest kind of "hinges" to mount: Finishing nails driven through the sides of the frames and into the door edges near the bottom to form pivots. The doors

are rounded slightly on the bottom edge so they'll clear when they swing. Magnetic catches hold them shut.

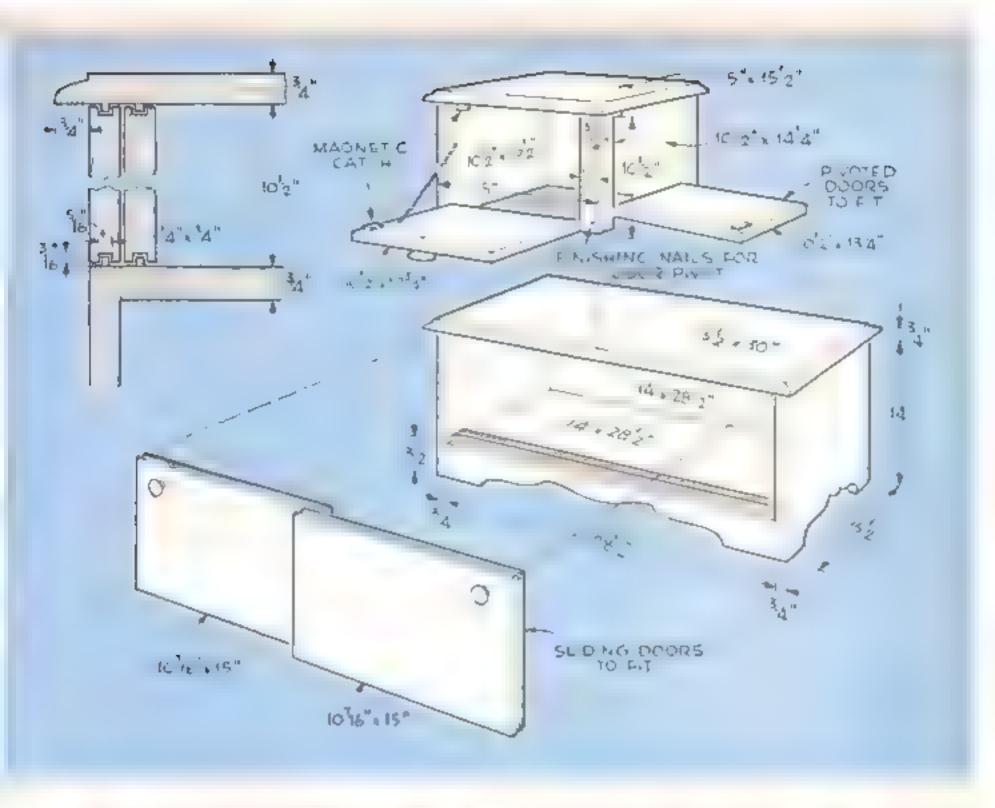
Disappearing act. These doors are designed to be inconspicuous. Cut them oversize, as if they were a solid front and side to the step—10½" by 14¼" for the side piece and 10½" by 14" for the front. Then cut ¾" off the front piece and 1½" off the side. These two narrow strips are glued together to form the corner, and the larger pieces become the doors. The grain thus runs continuously across the doors.



Deep-in-corner casters should extend at least it beyond the base—farther if earpet pile is very deep. Thickness of the block under the casters will depend on size of the casters.



Patterns for side and end pieces are shown above. Only one half the larger piece is shown. Since the two halves are identical, simply reverse the pattern to draw the other half



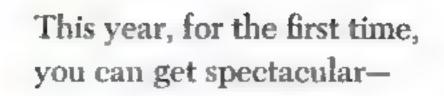
and corner, camoullaging the cracks. Pressing the doors at the lower edge opens them neatly without need for knobs.

Early American finish. On this traditional pine project, Minwax was used. The color was warmed slightly with two coats of orange shellae diluted with three parts of alcohol. This was followed by a final coat of satin varnish. It's a quick finish that looks good and will take a beating. Or you may prefer using your own favorite furniture finish.—Jackson Hand.



Save yourself sanding time by laying out fullscale curves on paper. Tape the paper to the wood and tack identical pieces together. Use a jig- or coping-saw to cut out the pieces.

Cylindrical surface-forming tool you chuck in an electric drill is a fast, clean way to smooth saw cuts. Faces of the curves will be hidden, so smoothing with forming tool is sufficient.



Christmas Colors from a New 'Rainbow' Plastic



By Henry B. Comstock

Christmas colors from white lights—and there's no magic about it either. You merely take advantage of natural laws and use a new transparent plastic incorporating a "diffraction grating." It breaks up white light into rainbow hues.

The spectrum-shaping stuff has unlimited decorative possibilities. Let's say you want a Star of Bethlehem, or a whole galaxy in a light box, to send a message of good will through a picture window. The ingredients are a small white light bulb for each star center, a black background, and two or more sheets of transparent grating. Crisscross the sheets a few inches ahead of

the lights. Out shoot radiating spikes, each crossbanded with stripes of red, orange, yellow, green, blue, indigo, and violet. The more sheets, the more spikes per star.

A second kind of grating—an aluminized, reflecting type—makes a handsome veneer for Christmas mobiles shaped from card-board. Every breath of air that stirs them changes the patterns that you see.

The diffraction grating has 13,400 parallel grooves to the inch, Its principle has been known for nearly three centuries. But only recently has its production cost been lowered to a practical level. Edmund Scientific Co. introduced it in the "Rainbow Showplace" at the Seattle World's Fair this summer. You can buy it from Edmund by mail order.

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To make the lights above, see page 176



A greeting box for the front window and a candle stand for the mantel are



White light breaks up to class is verse at the left and 12 to Draw 2 diagrams in a last that the sheet in placed with the punity of the right



F , Lt [1]T LELLO DI

No other dri Hike HI Genuine Jacobs chuck handles big jobs easily Change speed in a Jiffy; 3000 RPM for drilling thin metal and wood 1000 RPM for thick metal, wood, plaster, masonry. Burnout-proof motor gives peak performanceeven under load, Model 808. \$29.95.

Industrially rated—does everything a pattern saw will do-more than a circular saw or chain sawall with precision versatility, Cuts a 6" log. pipe, sheet metal ... fine scrollwork, too Complete with 7 blades, rip guide, circle cutter. \$44.95. Model 909

A (11 [1 1/4] 15 1 3 6 1 V D [[

3 sizes-each perfect for furniture refinishing, fine woodworking. Rugged molded plastic cases. Magnetic motors drive 14,400 strokes per minute. Extra power to ease work load.

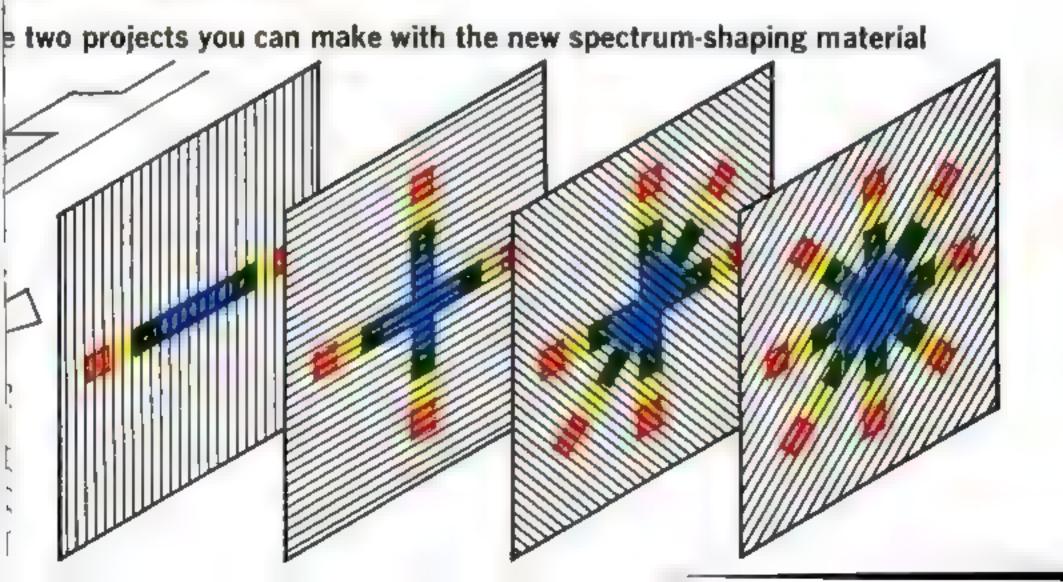
\$13.95 to \$19.95.





Candle stand has single sheet of reflecting material as a curved backdrop. Light from a billb made the base slunes on through slots and bounces off backdrop in a riot of color.

The light box has a transparent facing made of four sheets of clear grating arranged as shown in sketches below. A white Christmas light is at the center of each colorfid star.





FATELL 1

Gets into hard-to-reach places
Makes flush wall and floor cutouts. UL "Industrially Rated,"
1/3 HP motor. Seven blades included to cut any material from 6"
logs to delicate patterns to heavy
gauge metal and pipe. Model 920.
\$44.95.

Nothing on the market to equal this sander at a price even close. Sands coarse or smooth surface. Atmost dustless, weighs only 7 lbs. Open on one side for flush work. Belt turns at 850 Surface Ft. per Min. Includes 3 belts, coarse, medium, fine. Model 910. \$44.95.

Four models from slim 100 watt model, to the professional's standby at 250 watts for all-purpose heavy-duty work. All guns heat in 2½ to 5 seconds and work with a variety of changeable tips. Built-in spotlights focus on work. \$5.95 to \$15.95.

OOLS ... BEST BU YOUR MONEY

People everywhere know that dependable Wen tools offer far more for their money. More in brilliant design and engineering . . . new features to make doing a good job easier. Important advantages like 2-position handles on the "Double Duty" Drill and the Belt Sander to make your work more comfortable ... unseen advantages like spot welded burnout proof armatures to give your Wen tool longer life and greater efficiency. You get more basic quality, too . . . better materials to meet exacting professional specifications—yet built so efficiently that Wen tools fall well within the budget of the hobbyist and home fixer. Next time you need a power tool, buy a Wen. You'll not find a better.

Every 35 seconds ... 24 hours a day... 365 days a year Someone buys a Well tool

ROTARY ELECTRIC SHAVER

A precision product of unusual quality. Larger contoured shaving surface adds speed to traditional rotary comfort. Hollow-ground self-sharpening cutters shear whiskers cleanly without pinching. Brush and commutator motor adds years of effective life, \$19.95,



WELL PRODUCTS, INC., 5810 Northwest Highway, Chicago 31, Illinois



PS ELECTRONICS

New electronic circuit you can build gives

for Portable Tools

By Howard McEntee

I F YOU are like most users of a quarterinch electric drill, you've tackled a lot of
jobs when you wished you could reduce
the speed. Maybe you've even put a light
bulb in series or used a rheostat or a variable transformer. You know what happens
—the motor slows all right, but it's too feeble
to do any work.

You can now build a compact speed con-

trol that will slow a drill to a crawl and maintain practically the same torque down to about a third of the rated speed. With some drills you can drive No. 10

wood screws in pine at the pace you would turn a brace and bit.

The control will work on any series-wound universal motor (up to 3 amps' current). This includes motors usually found on saher saws, sewing machines, food mixers, some

sanders and fans, and small handheld grinders.

The device is also a light dimmer and will control the heat of any resistance-type heating appliance as long as you don't exceed its 3-amp capacity. You flick a switch (SW1) to convert it for a resistance load, and dial the exact heat you want from a soldering iron, glue pot, or heating pad.

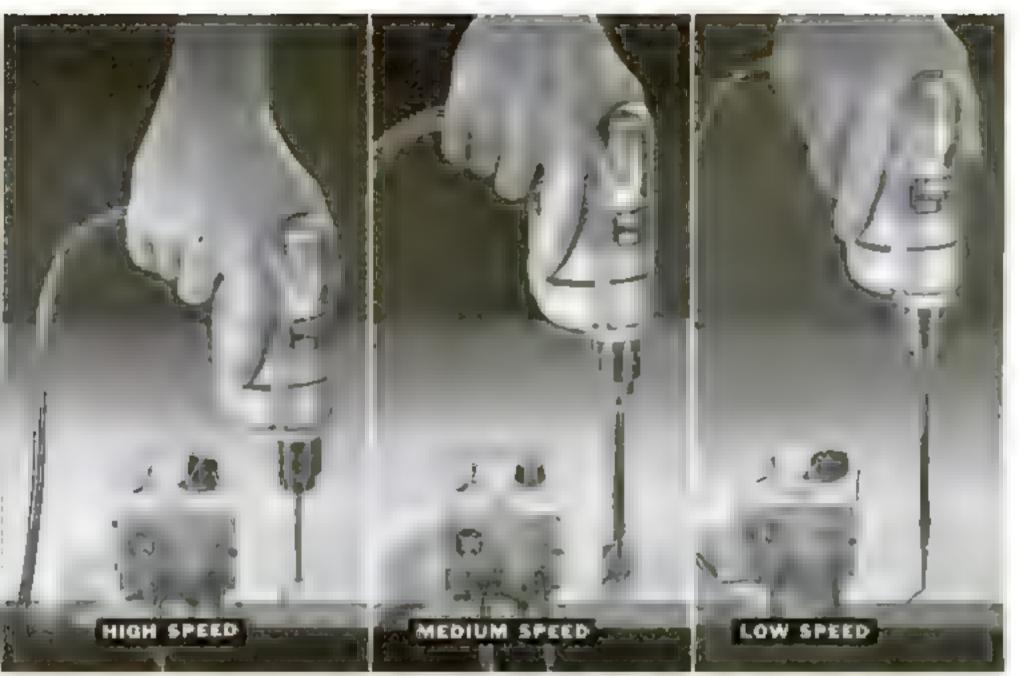
To use the control, you plug it into an outlet and plug the tool you want to control

> into the standard receptacle on the control box. Turn the knob on top to adjust the power output. Another switch (SW2) lets you bypass the electronic cir-

cuitry and apply full line voltage to the load. A built-in fuse guards against overload.

This remarkable little homemade control was made possible by a fairly new semiconductor device, a silicon-controlled rectifier (SCR), a cousin to the transistor. Its

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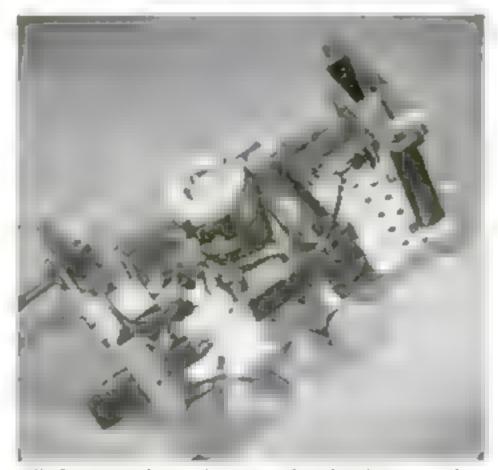


Small-size drills cut best at high speeds. Twist drills up to X" in chameter work fine in wood, ahiminum, or other soft materials at the usual speeds of small electric-drill motors. But you need slower speeds for steel with all but the smallest bits.

Larger-size spade bits work better at reduced speeds. You get a cleaner cut, the drill is easier to control, and your cutting edges will stay sharp longer. For drilling in steel with carbon-steel bits, the slower speeds are a must Screwdriver bits can be used directly in the drill chuck with the very slow speeds available from the control. However, at such slow speeds you can't run it continuously, You have to stop occasionally and let the drill motor cool off.

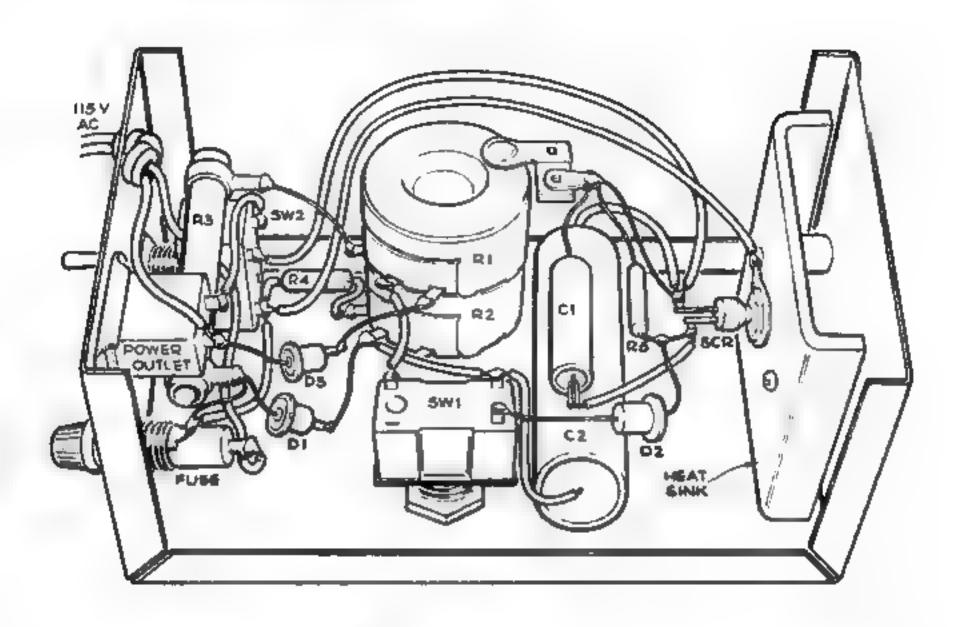
They've been made in sizes up to hundreds of amperes' capacity, but all have been expensive. Now, with increased production, prices of small sizes are within reach of hobbyists. The one used here: about \$6.50.

The big difference between this and more conventional ways of controlling motor speed is a part of the circuit called a feedback loop. This senses any slowing down of the motor due to loading and automatically causes more electric power to be delivered to the motor to bring it back up to the speed determined by the setting of the speed-control knob. This speed-sensing action depends in part on the magnetic make-up of the motor, so the control is more effective with some motors than with others. If you are using the motor for long periods at very slow speeds, you should watch the motor temperature. These motors depend on a built-in cooling fan to keep



All the parts fit easily into a handy aluminum box that is small enough to slip into your coat pocket. There's plenty of room for easy wiring. Note the heat-sink assembly at upper end of the case.

How to wire the speed-control circuit

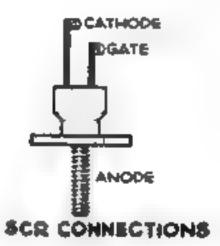


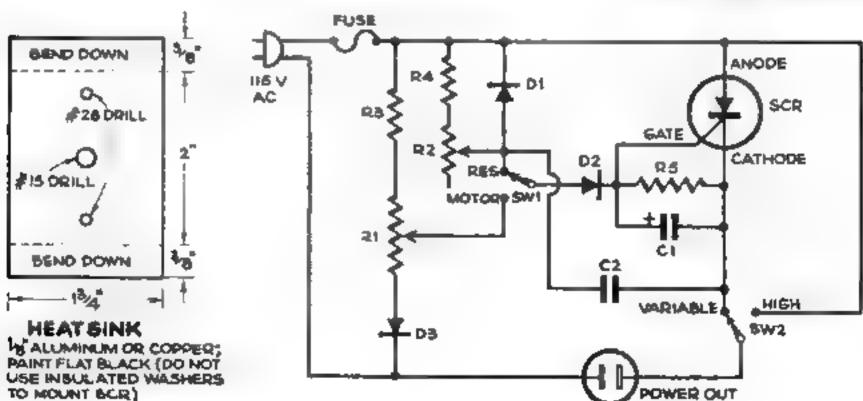
PARTS LIST

R1 250-ohm, wire-wound variable resistor 180 type # PS-250 R2- 10,000 ahm, wire wound variable remoter, IRC type W M 10,000 R5 -3,000 ohio, 10-west, more-wound resulter

R4 100 ohm, I watt, carbon resistor H5 1.006 ohm by unit carbon resistor C1-1 mfd., 50-volt, electralytic capacitor (2-1-mfd 100-volt paper capacitor (E-4-E silicon-controlled rectifier.) Type (158

111 - 6E villicon rectifer, 15 1695 D2. D3 GE ulleon rectifier, IN1693 S# 1, S# 2-Single-pole, double-throw topple agest bes I use holder, Littlefuse #362012 Fase Samp Busi type 464. Core - Sha "all' alla menama bon Muc -line cord ungle-lug terminal seesp, \maken alamenum for heat sink, heat sink maunting insulators, tubher haitun feet for case





them cool during continuous operation. At low speeds the fan doesn't blow enough air to carry away the heat in prolonged use.

Building the control. All parts will be found listed in most of the radio-parts catalogues. If you don't find the SCR listed, order it by the manufacturer's part number. The potentiometers, R1 and R2, are ganged on the same shaft. The part number given for R2 includes a kit of parts for attaching R2 to R1. If you have no interest in the resistive-load feature of the control, you can omit SW1, R2, R4, and D1.

Layout of the parts is not critical as long as you can fit them in. The SCH comes with insulating mounting washers so you can mount it directly on the case. But the heavy heat-sink mounting shown gives an extra margin of safety against overheating. Make the heat sink of X" aluminum plate and paint it flat black to improve its heat-radiating ability. Attach it to the end of the case, using tapped ceramic study or hor enade standoff insulators. The resistor, R3, runs fairly warm, so keep it away from the SCR and other rectifiers. Drill ventilating holes in the top, bottom, and sides of the case. Use rubber feet on the bottom so cool air can enter the bottom holes.

Be sure to observe the proper polarity when connecting the diodes D1, D2, and D3, If you accidentally connect one of them backwards the circuit won't work properly. Wire them in so the symbol printed on the side of the case points in the same direction as shown in the wiring diagram. Also watch the polarity of the electrolytic capacitor and and connect the plus (+) as shown,

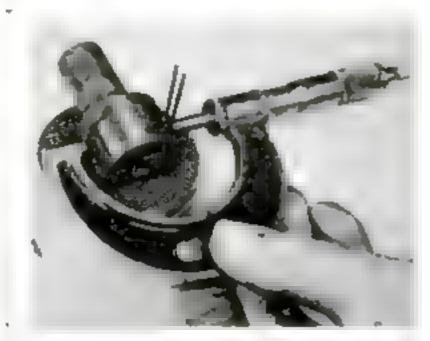
To test the unit after you are sure it is properly wired, plug it in, and plug your drill into the control box. Set SW1 to variable and SW2 to motor. Turn the knob to extreme clockwise position. Trigger the drill and you should find that it runs slightly slower than on straight line power. Flick SW1 to high (bypassing the circuit) and the motor should speed up. With SWI back on variable, the motor will slow down as you turn the knob counterclockwise until it barely turns or stops completely at the full counterclockwise position. Put a load on the drill at very slow speeds and you can actually feel the power pulses as the circuit compensates for load. Now you can dramatically demonstrate the effectiveness of this circuit by flipping SW2 to resistance. The motor will still run slowly but it will have no power.



Washable Ceiling for kitchen

Grease stains and high humidity—enemies of most kitchen and bathroom ceiling-tile materials—don't faze this new overhead surface. The easy-to-clean Marlite blocks are hardboard squares with a baked-plastic finish, in a choice of 11 colors. They may be secured with adhesive alone, applied to both ceiling and back of tile; or with concealed chips, inserted in tongue-and-groove edges. Block, adhesive, and clips are made by Marsh Wall Products, Dover, Ohio.

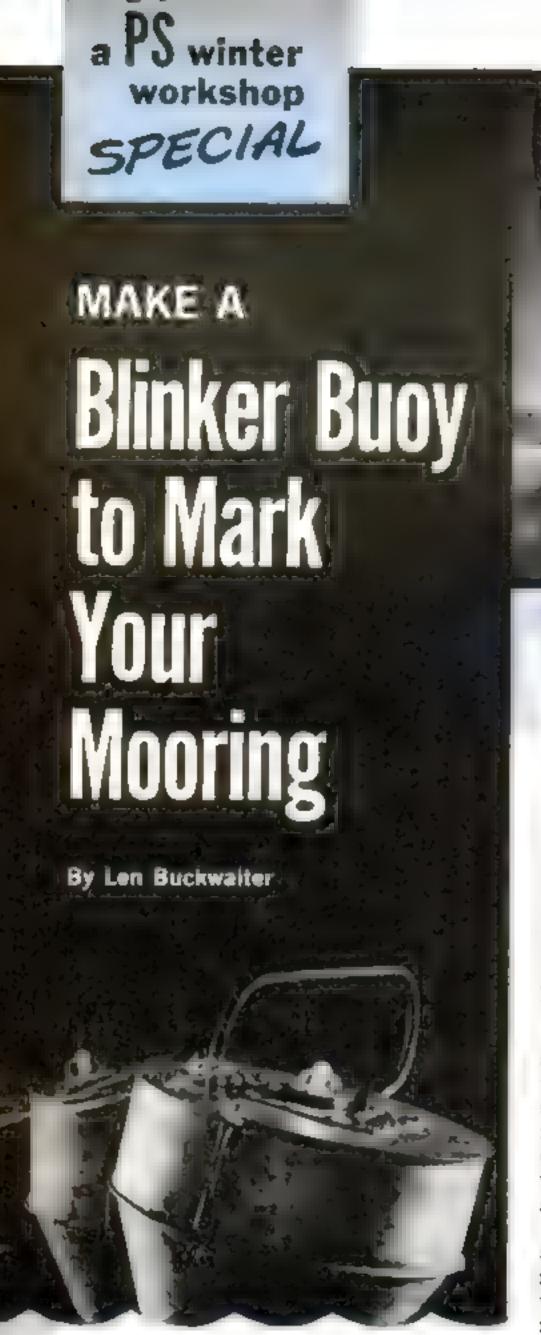
▶▶▶Line a big box with rubber shelf cushioning that comes by the yard, set the box at the back-door or basement entrance, and you have a catchall for wet rubbers, boots, and umbrellas. The shelving comes in a variety of colors.—Mrs. F. K. Turner, Masontown, Pa.



Use lead shot for a third hand

Measuring the pitch diameter of screw threads can be awkward. I sometimes find it handy to use a container filled with fine lead shot to hold the workpiece and wires in position while I make the micrometer measurement.—

H. J. Gerber, Menomonie, Wis.



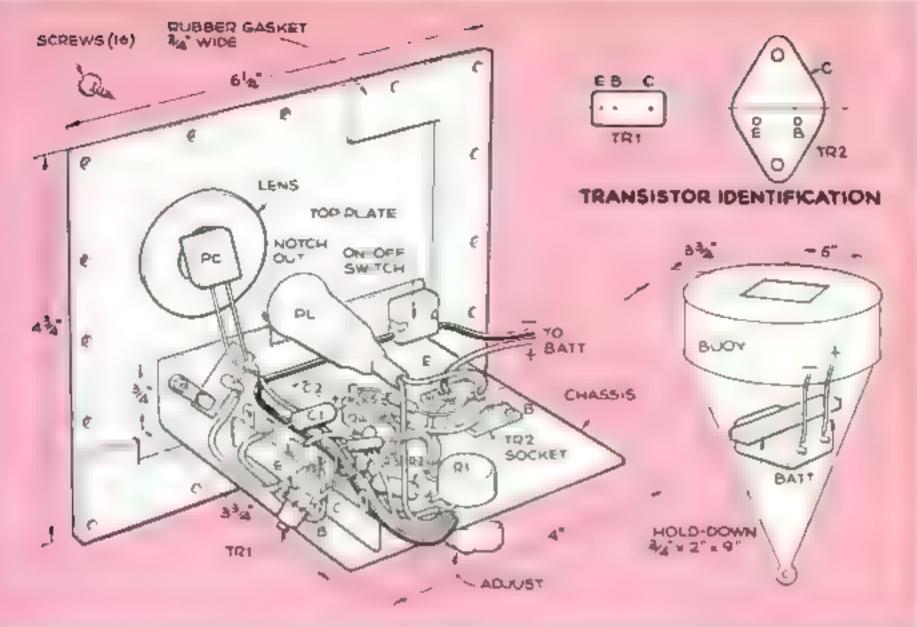
Mount all the parts except the battery on the top plate that covers the cutout in the buoy Battery is held in bottom of buoy by wooden hold-down secured in place by L brackets.

OU won't have to sweat out a late-evening return to your mooring if one of these blinking buoys marks the spot. It flashes automatically after sundown. You build it yourself using a standard galvanized buoy and a handful of radio-supply parts. The flashing light is visible on a dark night from a quarter-mile away or more. And it is miserly with current—one battery will last most boatmen a full season.

Secret of the thrifty operation is twofold: an economical transistor "flip-flop" switch that pulses the light bulb briefly once a second, and a photocell that starts it flashing after the sun goes down and stops it at dawn. You switch it on in the daytime when you leave the mooring, but it doesn't start flashing until dark.

Make the top plate of 18-gauge sheet aluminum. Drill holes for the sheet-metal mounting screws, bulb assembly, photocell window, and on-off switch. Fit it with a rubber gasket cut from an old inner tube.

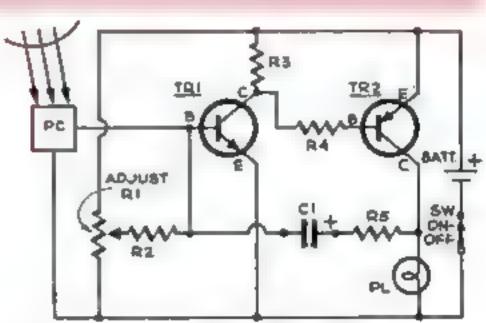
The bulb assembly is a standard item listed under anchor or range lights in marine-hardware catalogues. You have to modify its lamp socket to use the No. 47 bulb specified in the parts list. Crimp short pieces of No. 16 tinned-copper wire around



PARTS LIST

R1-10,000-ahm patentiameter, carbon-type linear taper
R2-6.300-ahm resistor, 1 mate
R3-1.300-ahm resistor, 1 mate
R4-2.30 ahm resistor, 1 mate
R5-2.300 ahm resistor, 1 mate
C1-30-aid minimizer electrotric capacitor 15-vols
TR1-2N120 translator
TR2-2N120 translator
PC-Photo ett, codmium sulfide type (Inforeste M\$ 739)
R-6-volt lantern battery i Burgest TW1, or equic f
SW-Pushbatton voltch 4C type
PL-No-67 pilot lamp
Runy Corronized flat-up type (Perku 13")
Matthe type anchor-light assembly
Tenasistor mounting kit (Motorola MK 10)

Flushight lens, 112" in diameter.



the pins in the bottom of the socket, and solder. Tape these wires securely and solder the free end of one to the contact on the base of the bulb, the other to the brass shell.

Use epoxy cement to mount the bulb assembly and the flashlight lens covering the photocell window, making a watertight joint with the top plate. Cement a medicine-dropper bulb over the exposed part of the on-off switch. The flexible bulb will let you push the button, yet keep water out.

Make the chassis from 18-gauge aluminum sheet and attach it to the top plate with the switch-mounting nut and a plated screw that also fastens the terminal strip. Wire

the circuit following the pictorial diagram and checking connections against the ichematic. Follow instructions in the transistor mounting kit for mounting the power transistor (TR2).

Make the initial checkout at your bench, but make the final adjustment outside in the daylight. Push the switch on and rotate the adjustment knob in both directions. The bulb should flash in full counterclockwise position and remain dark in clockwise position. Now face the photocell toward the

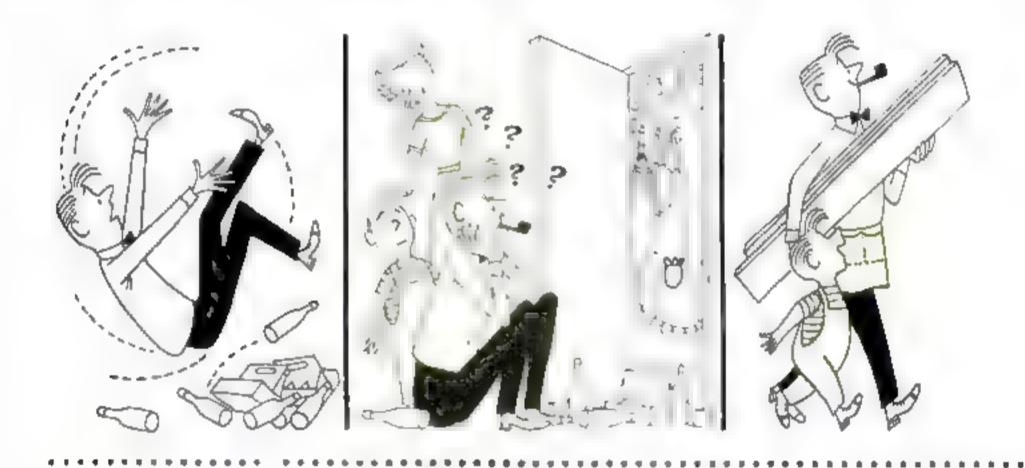
light and slowly turn the knobuntil it stops flashing but starts again when you cover the photocell window.

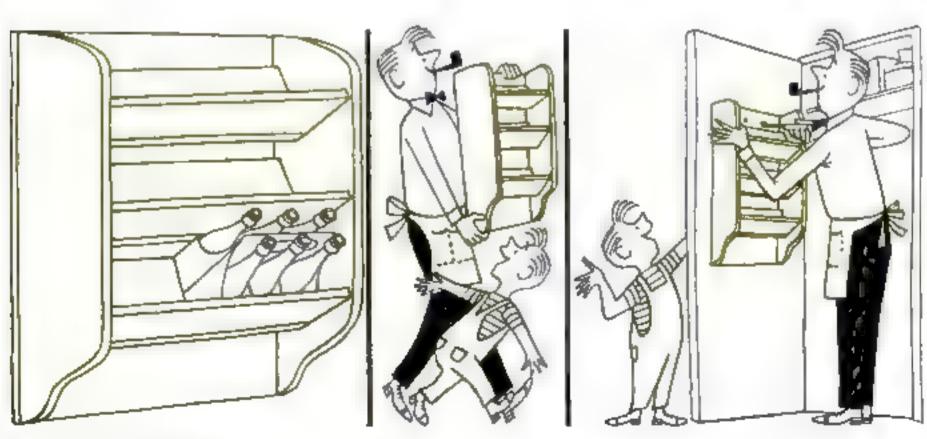


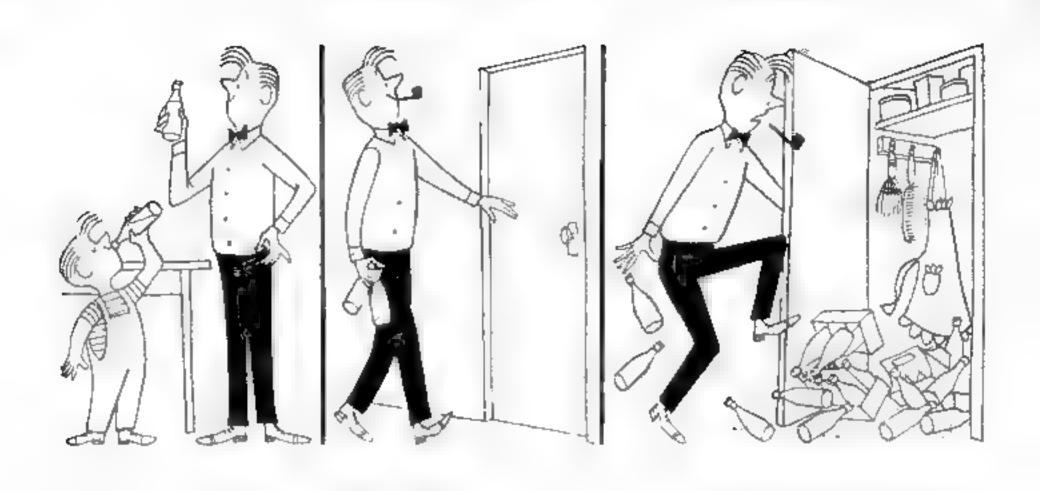
Wordless Workshop

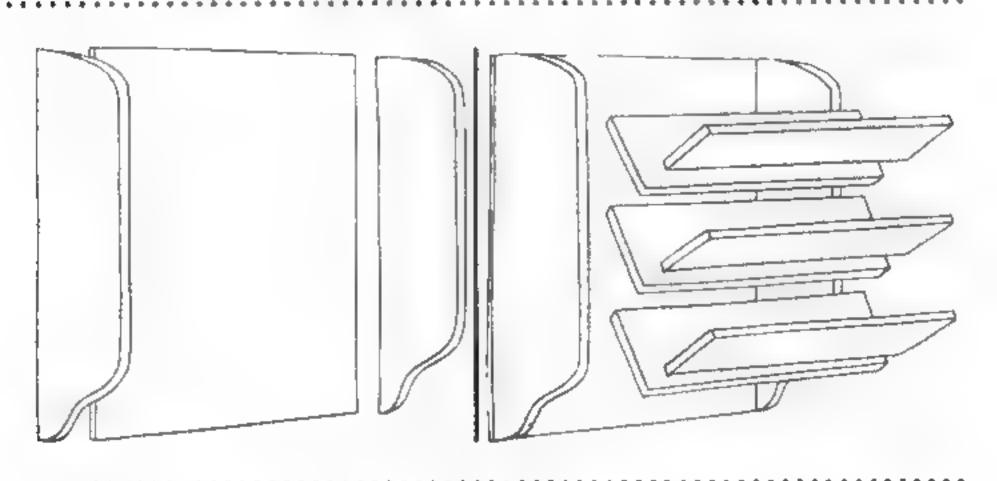
By Roy Doty and Arthur R. Tanner

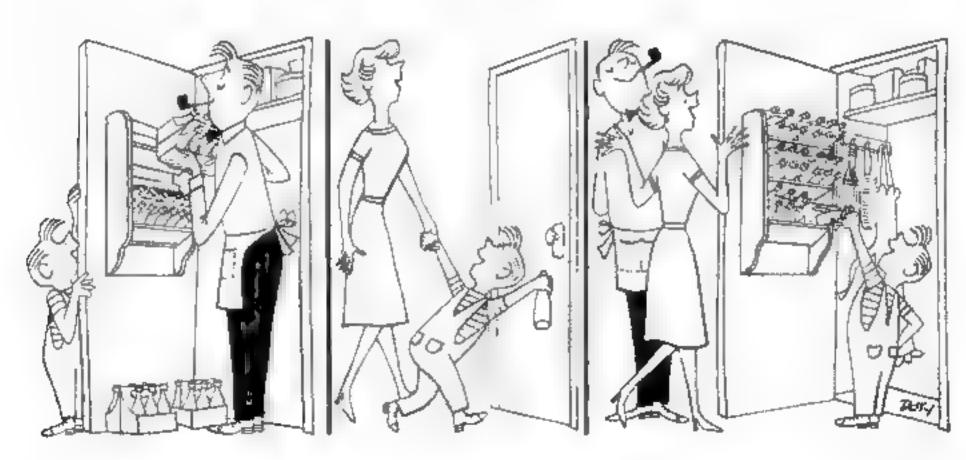












a PS winter workshop SPECIAL

"ISLAND" Shop Bench

concept in:

A new MAXIMUM TOOL STORAGE MAXIMUM WORK SPACE **MAXIMUM ACCESSIBILITY**

By Jackson Hand

TOU have never seen a workbench like this one before. It crams a whole workshop full of tools and materials into an island that occupies only a four-foot-square patch of floor space-no wall space is needed. Here's what you get in utility and convenience:

Drawers-17 big, roomy ones.

 Tool board—13 running feet, 30 inches high, and in the handiest possible location.

 Dustbin-you brush debris into a trap door centered in the top.

 Bench top—replaceable hardboard over a sturdy 15" plywood base.

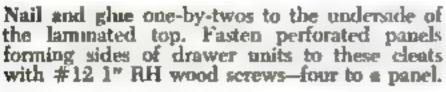
Workbench frontage-16 feet of it.

 Vise—corner-mounted so you can work at it from any angle.

 Knee room—plenty of freedom when you pull up a stool for sit-down jobs.

The unique design of this bench gives unbehevable rigidity with lightweight materrals and simple, easy construction methods. The cross-shaped base, with its rugged stressed-skin construction, is not only selfbracing but exposes a maximum area of perforated hardboard for hanging tools.







Make 15 drawer supports using 1" stock. They can be quickly fabricated by cutting all parts at once, using a cutoff jig, and fastering them together with corrugated fasteners.



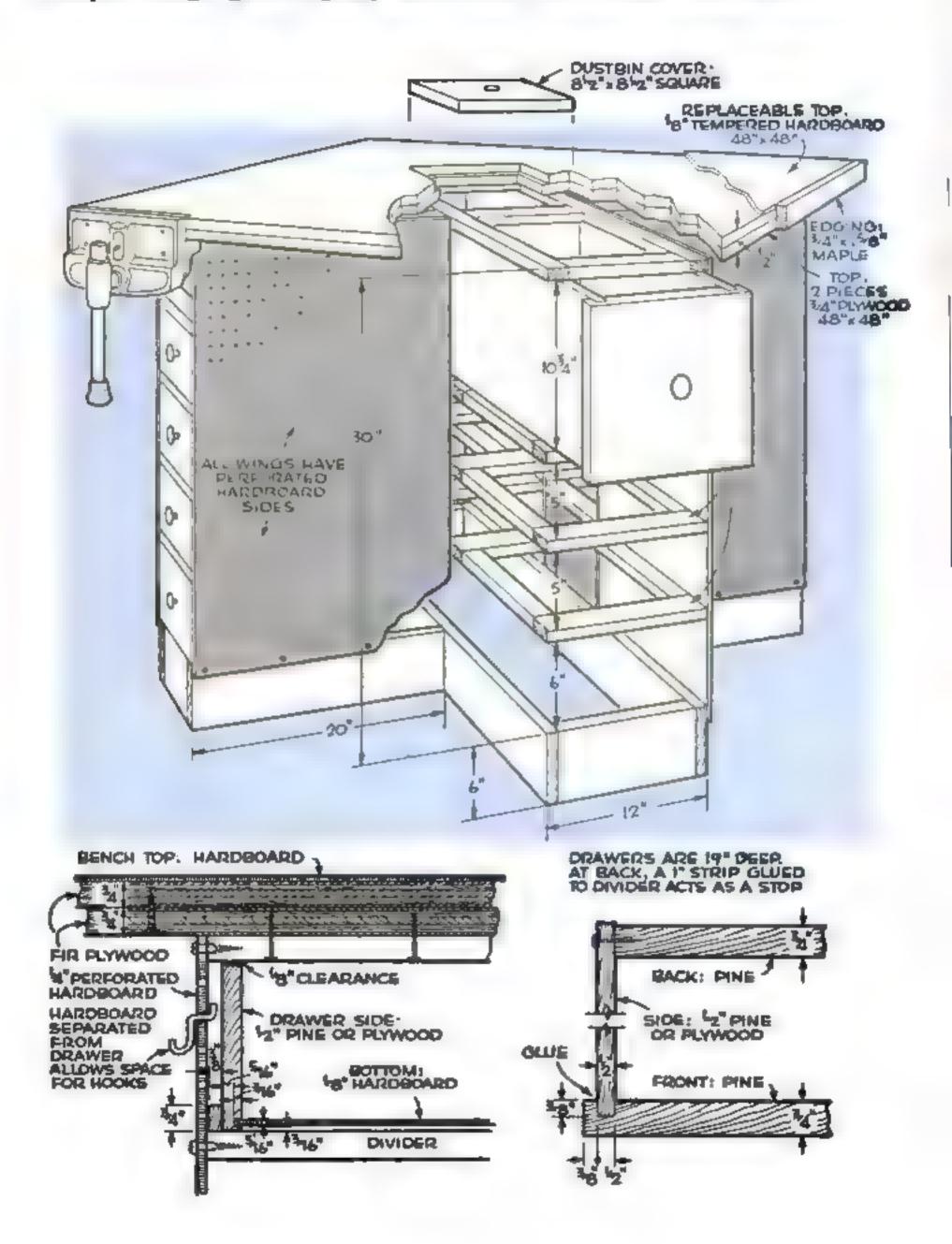
You work on all sides of this rock-steady bench and your tools are always at your lingertips



A quick trick for installing drawer supports accurately is to use four spacer blocks (two are shown clamped between supports) for the supports to rest on while you drave the seress.

Use 1" lumber for the base. It extends clear through on two of the opposing tiers. Other pair botts against this our and is not d to it becomes side panel to outside of base pieces.

Unique design gives rigidity and utility with simple construction



Glue I"-thick drawer guides to sides of drawers. These keep drawers centered in the opening and allow clearance to keep drawers from striking tool-board hangers.

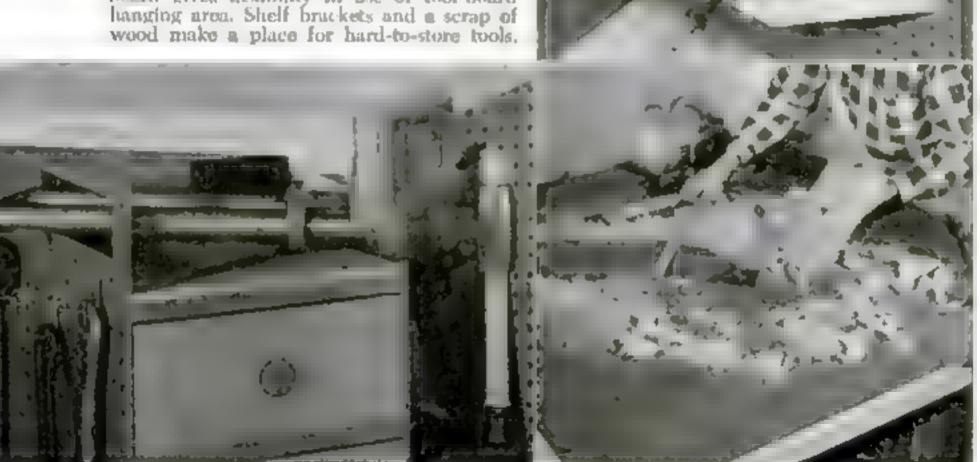
Build it upside down. Cut a 4'-by-8' panel of %" plywood in half crosswise, Make cutouts for the trap door in the center of each square and glue the two together to form the 15" plywood top. The hole in one piece is 8" by 8", the hole in the other 8%" by 8%". The piece with the 8"-by-8" hole becomes the bottom of the plywood sandwich. This gives you a %" ledge for the lift-out cover to rest on,

In building the remainder of the workbench, place your laminated top bottomside-up on the floor and work with the bench upside down until you are ready to put on the hardboard work surface.

The understructure is designed on a 1" module to correspond with the spacing of the holes in the perforated board. This gives you ready-made clearance holes for the screws fastening the top, base, and drawer supports to the perforated panels

Ordinarily the replaceable hardboard top will lie flat and be held in place by the maple edging. If it tends to lift, put a dab of white glue under each corner. You can easily pry it loose when the time comes to replace it.

Wide range of hanging hardware for K" loand gives flexibility in use of tool-board



To mount the vise you'll sacrifice one drawer space. Size and shape of the cutouts you'll have to make in the side panels will be dictated by the particular vise that you plan to use.

Lift-out top opens into dust drawer, which is twice the height of the other drawers and extends clear across central opening. It stops against regular drawer stop in opposite tier.



For shaping jobs you never dreamed possible, try this ingenious team:

Hitch a Hand Grinder

By Herbert R. Pfister

DAPTING a husky hand grinder to a lathe is like getting an expensive new machine free. The combination will handle dozens of jobs that neither tool could do alone—plus many operations you've never dreamed of performing in a home shop.

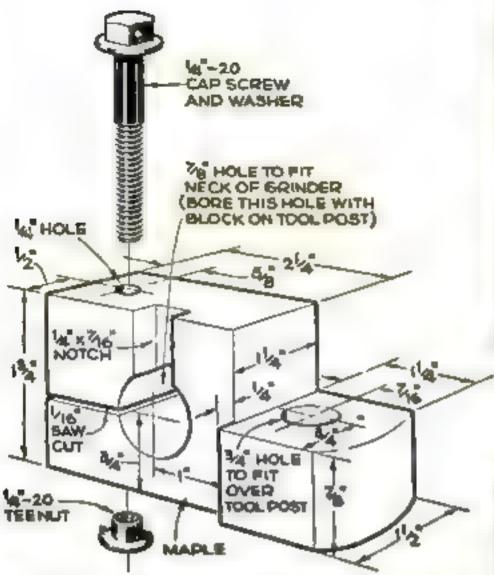
Clamped securely on the lathe tool post, the grinder is no longer dependent on your hand to guide it. It becomes a precision machine, capable of working to thousandths-of-an-inch accuracy.

The lathe, with its precise horizontal movements, automatic feed through the lead screw, and indexing head for dividing one turn of the spindle into 360 degrees,

makes an ideal master fixture for the grinder. For many standard lathe operations, the grinder serves as a power cutting bit, producing a smoother finish than could be obtained with the sharpest fixed cutter.

Maple block does the trick. The beauty of this marriage of two tools lies in its simplicity. A block of maple that you can cut to shape and bore in half an hour joins the tools rigidly. No easting or machining of a massive chunk of metal is required to support the lightweight grinder.

One hole bored in the block fits over the tool post. Another hole receives the neck of the grinder. A %" cap screw threads into a Teenut set in a third hole to lock the grinder in place. The block illustrated was made to fit the Dremel Moto-Tool and



Simple split-collar block clamps the grinder solidly to the lathe's tool post. At left, the grinder puts a new 60-degree point on a scarred center, guided by the compound feed.



Hole for the grinder is bored on lathe's exact centerine by clamping the block square on the tool post and feeding it into a bit driven by the headstock chief.



Split block is squeezed tight by turning a cap screw into a Teenut on the underside. Notch above the hole allows clearance for a boss on the grinder's neck.

to a Lathe

Atlas 6" lathe. It can be tailored to fit any combination of tools.

Its uses are endless. Some of the many jobs you can do are shown here, along with the setups used to achieve the startling results. It's easy to see that the versatility of the teamed tools is limited only by your imagination and the scope of work you do in your shop.

If you tinker with cars, you can grind valves, undercut starter and generator commutators, and machine many small parts that can't be bought individually. A model-maker can turn out in wood, brass, or plastic the many special shapes—hex, square, triangular, tee, channel, 1-beam—that go into the building of a model from scratch. The possibilities for decorative



Grinder mounting block is locked on the lather compound by a 5/16" cutter but placed crosswise in the tool-post slot. The bit distributes pressure evenly.



work-flutes, spirals, tapers, even threads in wood-will delight the woodworker.

The list is as endless as the variety of cutters, granding wheels, routers, and other accessories available for the grander. You can even put tray dental burrs to work. Ask your dentist to save you some. He discards them when they begin to run hot, but they're still plenty sharp.

Drilling boles in a circle is quick and accurate this way. Grinder is located off center a distance equal to the desired radius, and the indexing head spaces the holes automatically.



As a power chisel, grinder produces a smooth finish Rough finish at left was made by ordinary cutter. Taper was turned by setting the tailstock over and moving carriage manually.



Routing flutes with a ball cutter is a breeze with this setup. Work is locked stationary and the grinder moved along lathe bed. The indexing head automatically spaces the flutes.



You can mill her shapes on rod by sliding the grander sideways while giving the rod a %

turn for each flat. For uniform depth, cross feed is advanced same amount for each pass,

SHOP TALK By Sheldon M. Gallager



Try this quick-mount trick for sanding disks

Ran across a neat way to mount abrasive disks on a sander. You merely stick a few strips of double-coated Scotch type on the back. The tape, also sticky on the outside, then holds the disk to the sander plate. Best arrangement on big disks proved to be a series of strips around the rim, plus one across the middle, as below. On small disks, three strips in a triangle are enough,

Nice thing about the method is that you can prepare the disks ahead of time and strip off the protective backing paper just prior to use. The disks can also be peeled off and remounted as long as you keep the stickum clean with a sheet of way paper or foil. The trick is based on a similar technique used in industrial shops. The only difference is that the pros use extrawide tapes not available to the public. The narrow type is easily obtained at hardware, variety, and stationery stores,





For free: How to pick sandpaper

Speaking of abrasives, the Behr-Manning Co has a handy hang-up wall chart designed to help you choose the right abrasive paper for a variety of tools, materials, and finishes. You can get one by writing the company at Troy, N. Y.

More about left-hand drill bits

We mentioned recently that left-hand wood bits are available for left-turning motors found on radial-arm saws. Now a Florida outfit writes to remind us that left-hand bits are also available in metalcutting types, chiefly for industrial use. Our thanks to Williams Machinery Sales, 3805 W. Buffalo Ave., Tampa.

Smart idea: Easier drywail corners

Here's a nifty answer to that old chore of fastening metal corner heads to drywall paneling. It's a paper-faced aluminum strip that comes flat in a roll. You just snip off a length and run it down the corner, creasing it as you go to form an inside or outside bend. You simply bed it in joint cement. The maker: Rutland Fire Clay Co., Rutland, Vt.

PS winter workshop

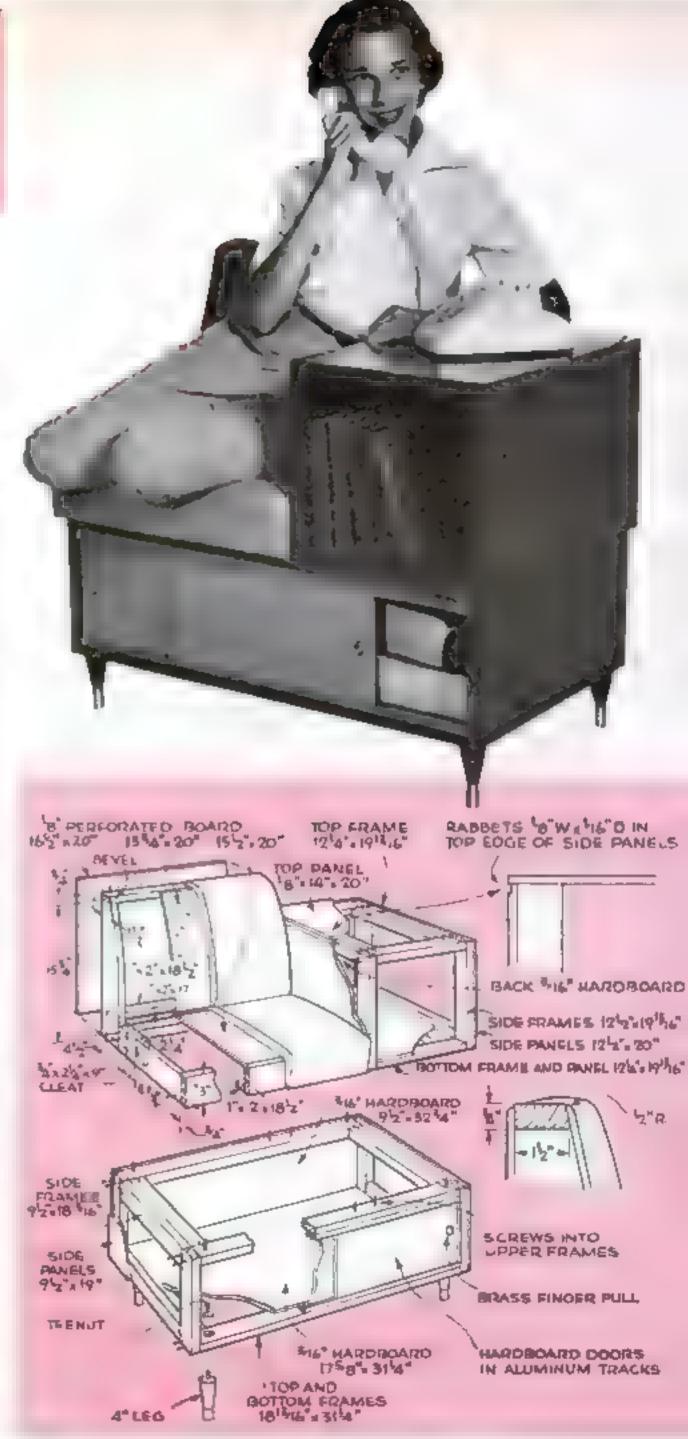
A Colorful Gossip Bench of Hardboard

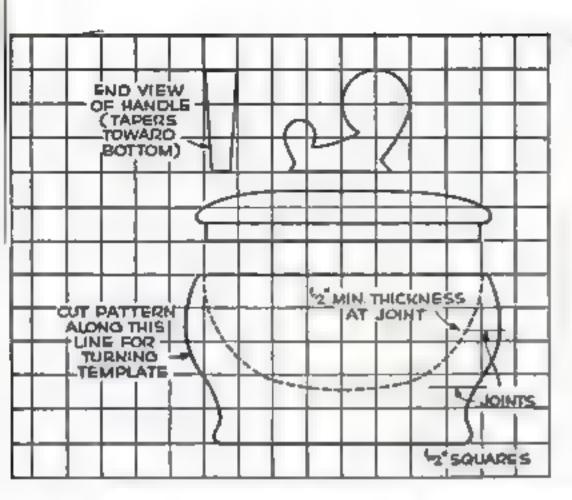
Comfort while telephoning is combined with storage for directories and other bulky items in this attractive gossip bench. It's a simple wood frame covered with plastic-faced hardboard for a hand-some appearance.

The seat and back are padded with %" foam rubber, covered with vinyl upholstery. The sliding doors below the seat are hardboard with the same vinyl upholstery cemented on. The doors slide in aluminum tracks sold at hardware stores.

You can build the bench as three separate units and then assemble them. All frame members are one-by-twos except the front and back rails of the base, which are one-by-threes. Assemble the frames with glue and corrugated fasteners. Glue and nail the side frames to the top and bottom frames.

The seat panels are %" perforated hardboard. Cut the foam rubber %" wider and longer than the seat, then undercut the side edges at 45 degrees. Fasten the upholstery over the rubber with contact cement and upholstery tacks at corners. The plastic-faced hardboard panels also attach with contact cement.





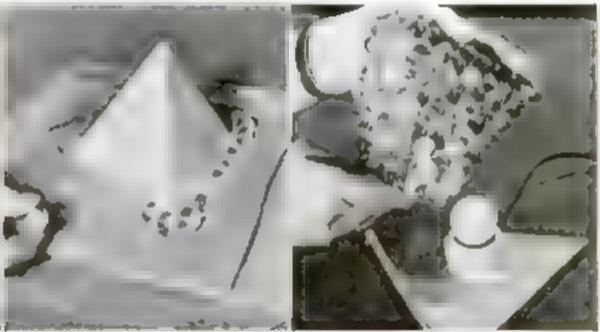




Lathe-turned jewel box in rings of contrasting grain

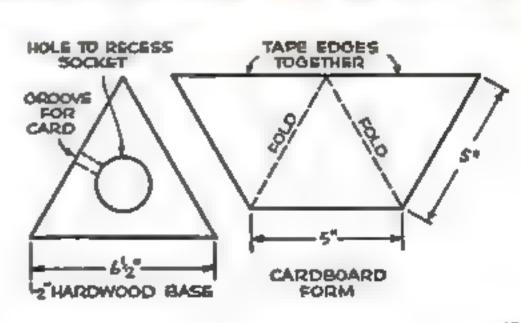
The special character of this turning comes from the way the block is glued up. Instead of using layers of contrasting wood. "" disks of the same wood (mahogany) are rotated so their grain runs in alternate directions. Turn the bowl first. Then screw the lid block to a disk of plywood, which, in turn, is fastened to the faceplate. After shaping the lip, mount a scrap of "softwood on the faceplate and cut a recess to hold the lip for turning the top.—T. C. Van Alstyne, Don Mills, Out.





Night light of stacked marbles

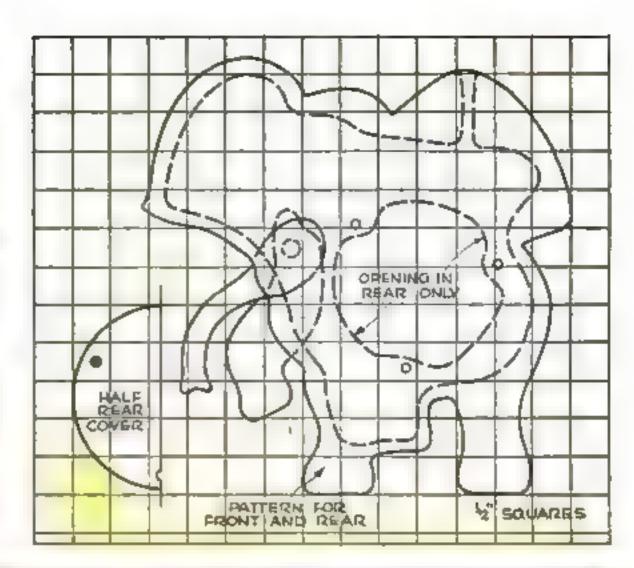
Cat's-eye marbles built into a pyramid make a colorful shade for a night light or TV lamp. Fold a cardboard form as shown and cover it with wax paper. Dab clear cement on the marbles where they touch. Glue only three rows at a time or the marbles may slide. Place the pyramid over a 7%-watt bulb on a triangular wood base.—W. and E. Waltner, Hurley, S.D.

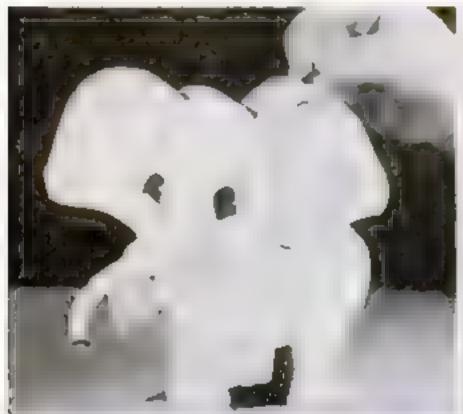


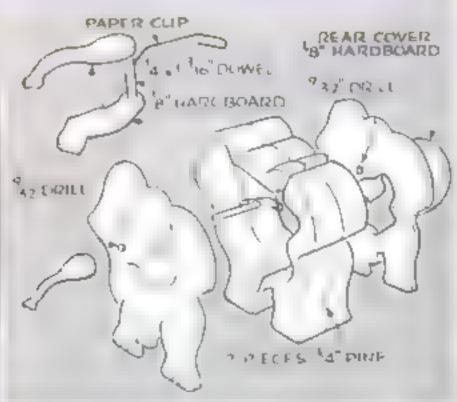
PS winter workshop

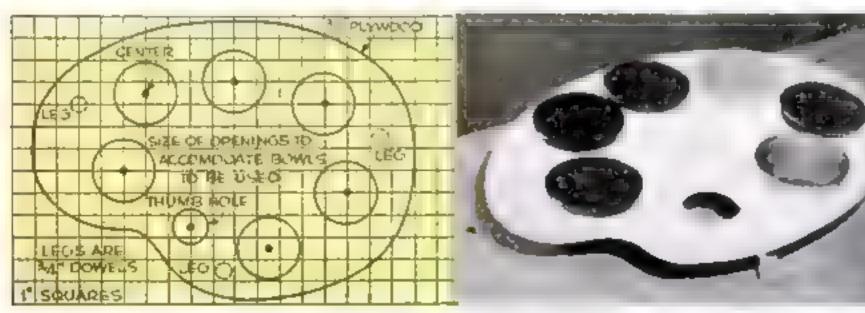
Animated bank encourages children to save

Every time Junior plunks a com in the slot, Jumbo responds by swaying his trunk and lifting a hoof. The coin upsets a paper-chp balance lever connected to the trunk and leg. Assemble Jumbo with glue and three screws. Except for the body markings, the wood may be left unfinished—C. Smapl, Flushing, N. Y.





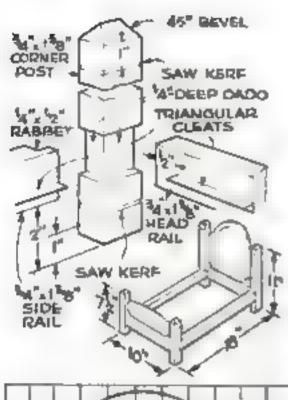


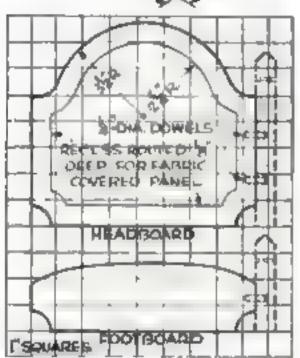


Snack tray gives guests a choice

Six bowls, each a different color, are the "paint dauls" on this artist's palette. A snack tray for nuts, olives, and cracker dips, it's

cut from ** plywood and rests on short dowel legs. Attach the legs with screws countersunk into the top and puttied over before you apply enamel or stain the wood for a wax finish.—Hi Sibley, Nuevo, Calif.





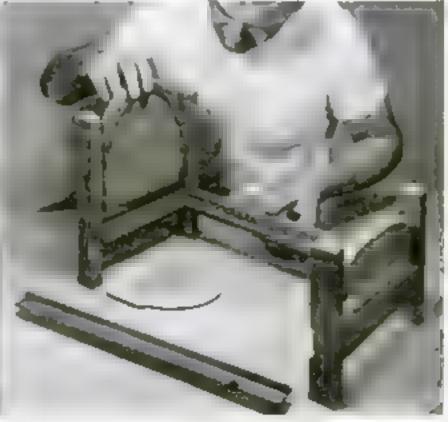


A sturdy bed for sleepy dolls (or kittens)

Be warned: You can't do a shoddy job of furniture making with an eager six-year-old watching your every move. Any young homemaker will cherish this doll bed—and it's a good exercise in craftsmanship for you. The one shown is made from %" walnut, assembled without nails or screws. The four corner posts are each notched on two sides so they hide all rail ends. After sanding, brush on two coats of resin sealer or satin-finish varnish. Cut a slab of %"-thick plastic or rubber foam to make a comfortably springy mattress.—John Burroughs.



Headboard is routed to take a separate insert, then puned to the corner posts with dowels. The insert can be %" plywood or hardboard, covered with thick fabric to simulate padding.



End grain is concealed by notching the rails into the corner posts. Tiny cleat strips tacked to the rails support a hardboard bottom. After gluing, clamp assembly with rubber bands.

PS winter workshop



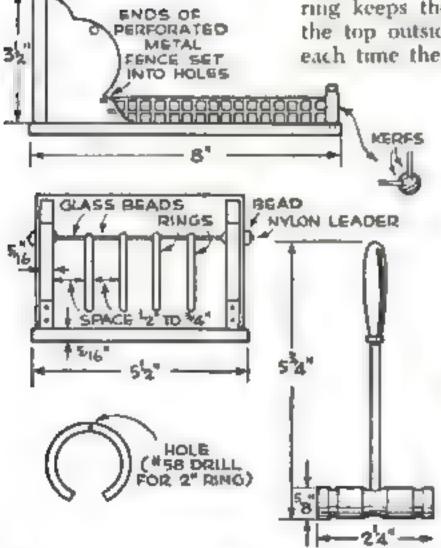


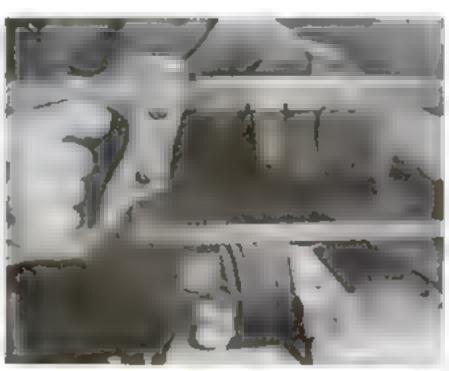
Two household gongs made from coil springs

Slice a large coil spring into split rings and you have the makings of these two household goings. Suspend one ring on a thread at the point opposite the cut, and tap lightly with a small mallet or metal rod. This is the lowest note of your going. Time other rings to a higher pitch by trimming the ends with a file or saw until you have varying notes.

Polish the rings with abrasive cloth and wipe on a very thin coat of wax, oil, or shellae to resist corrosion. Drill each ring crosswise opposite the cut. Lightly countersink the hole so the edges won't cut the nylon cord used for stringing the rings. The fenced tray of the dinner chime stores the mallet Tiny beads separate the four or five rings used. Space them %" to %" apart.

The jingler has five rings spaced X" apart on cord hung from a metal coil. The parts are mounted on a X" plywood plaque, made either in one or two pieces, and about 2X" wide and 9" long. A dab of household coment below each ring keeps them from sliding together. When mounted at the top outside corner of a door panel, the rings sing out each time the door moves.—Walter E. Burton, Akron, Ohio.





Annealed coil spring—this 2" one was salvaged from a washing machine—can be split into rings with a single backsaw cut. To soften the steel for cutting, heat it red hot first.



Sturdy hardwood stand for a bench tool

My shop stands are sturdy enough to support the heaviest tools, yet handsome enough to go in the living room. The design provides rigid support, yet is so flexible that it can be adapted easily to almost any bench tool.

I made my stands of birch, though any seasoned hardwood is satisfactory. I used a table saw to cut out the pieces to the dimensions shown in the drawing. To saw out the rail ends, I set the miter gauge at 83 degrees. I then carefully marked and drilled the holes for the leg-to-rail bolts.

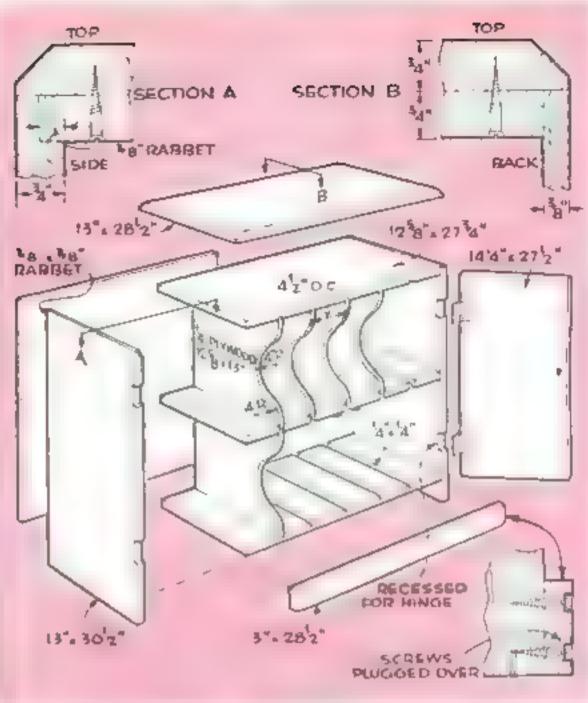
An expansive bit is best for drilling the large blind holes that house the nuts at each joint. I test-fitted the joints before marking and drilling the dowel holes. A dowel pin at each joint keeps the wood from twisting, though it may be omitted. I made the top by gluing up 1" stock, and fastened it in place with 1%" No. 10 F.H. wood screws, countersunk. I completed the job by plugging the holes.

A good finish is a tough, clear acrylic. It's highly resistant to oils and wear.—

Joseph Olivari, Gardner, Mass

PS winter workshop

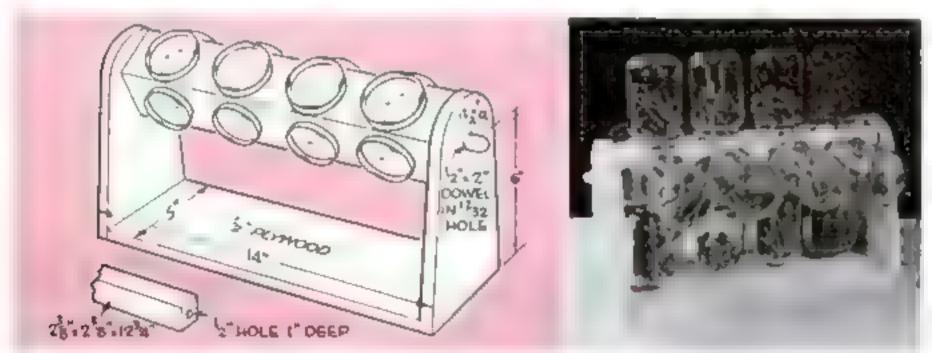




A birch cabinet for your records

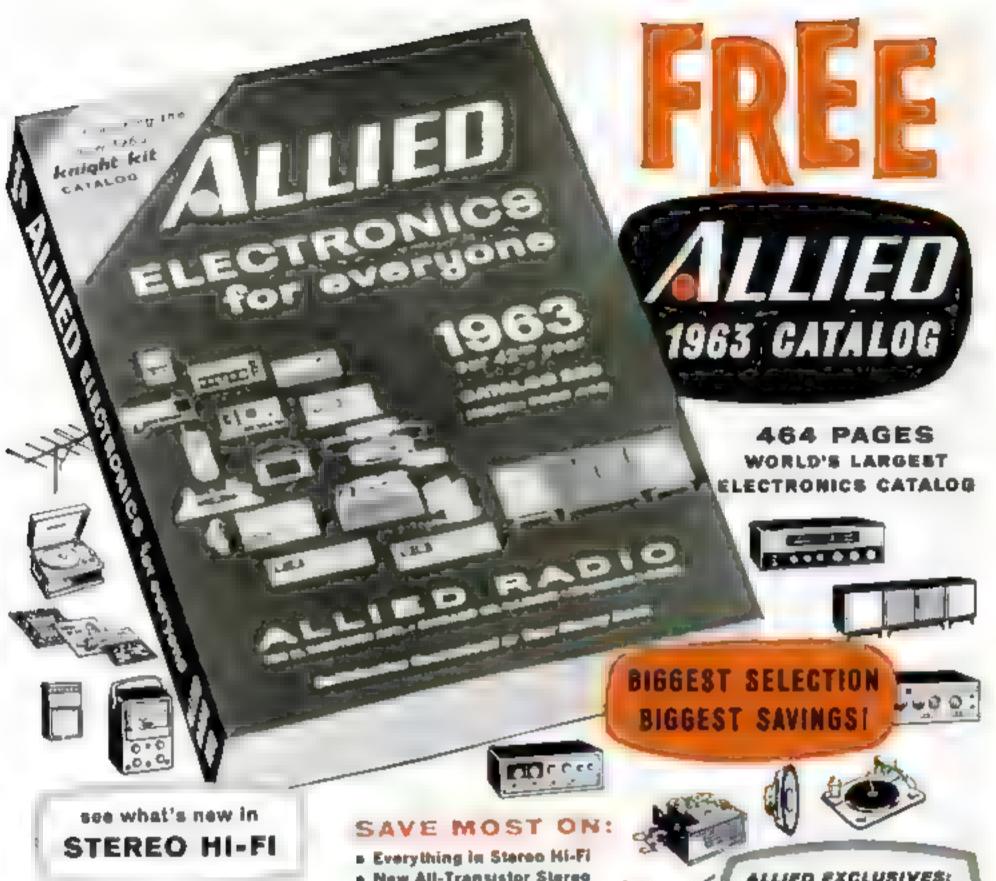
Designed as a handsome piece of livingroom furniture, this record cabinet combines utility with ease of construction. It's put together with butt joints and all cuts are simple: dadoes to form compartments and mortises for hunges.

With all the dividers in place, the cabinet will hold 250 LP records. With unused dividers removed, there's space for general storage.—Hi Sibley, Neuvo, Calif.



Rotary cabinet for compact storage

This small-parts Ferris wheel beats hodgepodge shelf stacking. Instead of lifting and replacing a raft of containers to find a nail or a screw, you just twirl the jar carrier. Parts are easy to see through the glass. Use baby-food jars with screw-on tops. Screw the lids to a 2%"-by-2%" solid block or one boxed up of %" plywood. Mount the revolving parts carrier in the frame with %" dowels.—C. Sinapi, Flushing, N Y



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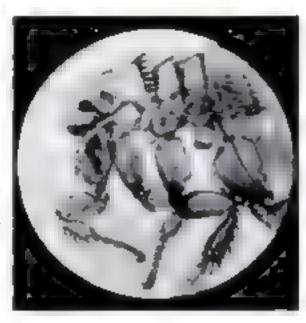


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Gus Tackles a Noisy Problem

By Martin Bunn

HIS the fan belt you wanted, Boss?" asked gangling Ted Beamish, the Model Garage's teen-age helper. "The parts man said he doesn't get much call for these wide ones any more." "Aren't many '41 cars like Mrs. Flanders' around," returned Gus. "Got any real work for me? Like on a car, may be?" pleaded the young helper.

"Well, the Flanders car is over there," said Gus. "Think you can

put on that fan belt?"

"Oh, sure," returned the boy loftily. "That's just basic training

in high-school auto shop."

"Go shead then. But remember to-" Gus found himself talking to empty air. Ted had grabbed the new belt and scurred off. Then the phone rang, making Gus forget what he'd meant to say.

A horn sounded outside and Gus opened the big doors. A '59 hardtop rolled in to the accompaniment of a jackhammer racket from a street-repair job outside. Gus lowered the door to restore comparative quiet. The driver of the car, a burly, black-browed man in a checked shirt, sat scowling until Gus came over

"I've got a noise in this car that's driving me nuts," he said, "Listen" Gus put his head inside on the driver's side. Over the engine's tick came a sound indivay between a squeak and a rattle. Nearby,

Ted raised his head to listen.

"Seems to be coming from the steering column," muttered Gus.

"But it could be telegraphed from farther down."

The driver jerked up a chin like a cliff. "The last garage I went to said the same thing. They thought it might be the directional-signal plate. I had to wait three days for them to get one. They put it in, but when I drove out, the noise was just the same. Now they tell me to drive it a few days more and see if it stops. I'll go crazy first!"

The man put a cigarette in his mouth and lit it with shaking hands. "Give us a couple of hours," said Gus. "All we can promise is

to try."

The customer got out of the car. "My name's Mecker. I'll be back in a while."

Gus stretched out on a crawler and rolled under the car, letting the engine run. The noise was still audible below. He held the edge of the splash pan and grasped each end of the tie rod in turn. The sound persisted. Gus rolled out just in time to see Ted jockeying a floor jack under Mrs. Flanders' car.

"What're you doing?" he asked.

"Putting on that fan belt," answered Ted, a defensive quaver in his voice.



"I'm going to lift the engine," the part-time helper explained. Gus shook his head. "Put the jack away, Ted, before you break that motor mount."



Gus spied the old belt on the floor. It had been cut apart.

"Tough getting that off?" he asked.

"Boy!" retorted Ted feelingly, "I never saw one so tight. Even with the generator slacked off, I had to saw the old belt apart to get it out. That new one's worse yet. Course, I could pry it on if I had to—"

"Not in this shop," said Gus sternly "That goes for any belt, on any car, new or old. The cords in a belt have no stretch to 'em—they're designed not to have any. Pry one on, or use that trick of some all-

thumbs mechanics—forcing it over by cranking the engine—and you know what happens?"

Ted swiped oilstreaked red hair out of his eyes. "No, I guess I

don't."

"That belt looks good as ever. But after a few days the strained cords tear. Then it's unbalanced. The belt turns over in the sheave groove and just rips itself apart. When you put on a new belt in my shop, Ted, take the time to yank the generator or do whatever's necessary to install it without straining its guts!"

"Well, gosh, that's what I'm doing," returned Ted plaintively. "I wasn't going to pry it. On this crate the front motor mount's conked out and lets the engine down so far I can't push the belt in between the pulley-damper and the splash pan. So I'm going to lift the engine."

Gus shook his head. "Put the jack away, Ted, before you break that motor mount."

Crestfallen, the boy did so.

"What I tried to tell you before you took off," Gus went on, "is that the vibration damper has two flats on it. It's rim is so near the splash pan you can't slip the belt between. But turn either flat down and it's a cinch."

"So that's it!" sighed Ted. "Okay, I'll give

it the old try."

Gus watched as he pulled out the ignition-coil cable and twitched the motor around with short starter bursts until it stopped in the right position. The boy shd the belt into place. "Never had one like this in school," he said with great relief.

"No," agreed Gus soberly. "They just don't make 'em like they used to."

Driving Meeker's car around the block, Gus heard the annoying squeak-chirp turn into a buzzing rattle on acceleration. He hegan to understand how it could get on Meeker's nerves.

"I have to go downtown on an errand, Stan," Gus told his senior helper on returning to the shop, "Track down this noise.

Some other shop already did work on the wheel; but you might check inside the steering column. It's a fair bet it's in the linkage."

Going out to where his car stood at the curb, Gus was surprised to find Meeker standing near it, apparently absorbed in the street-repair job and untroubled by the racket. He exchanged a few words with him and went downtown,

Stan removed the horn ring, the steering wheel, and a directional signal plate that was plainly new. He found the rubber steering-shaft bushes

intact. The noise persisted even when he pinched the shaft tight, eliminating any possible vibration. The shift-linkage shafts were not touching anywhere inside the column.

Stan replaced the signal plate, wheel, and horn ring, and left to answer the phone. He was still on the phone when Meeker walked through the office door.

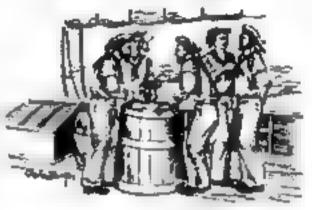
Ted spotted him, "No, sir, he hasn't found the noise yet," Ted told the big man. "Say, maybe if somebody rode with you he could listen other places than up front."

"I never tried that. It might help," agreed Meeker, cracking long, calloused fingers nervously. "I'll wait."

"What for?" asked Ted, seeing Stan still at the phone. "Come on, I'll go along."

Meeker got behind the wheel. The sound of air hammers, as the shop door opened, alerted Stan Hicks in time to see the car pull out.

Where'd it come from?



"Scuttlebutt"

On a ship, the butt, or eask, that held the day's water supply was called the scuttlebutt. Lake the office drinking fountain to-day, the scuttlebutt was the crew's meeting place for idle talk—hence the world's use now, in the Navy and out, to mean rumor or gussip.

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AC SPARK FLUG S THE ELECTRONICS DIVISION OF GENERAL MOTORS

Ted sat up front, head cocked and rigidly attentive. The noise still seemed to come

from near the steering column.

"Hold it," said the boy. "It could be telegraphed from any place. Let me ride the trunk. If it's from a rear spring or shock, I'll hear it there."

Meeker stopped. He seemed dubious when Ted jumped into the trunk and told him to close the hd.

"Sure that's a good idea?"

"Got to, or the lid will clatter and the



hinges squeak," the boy insisted. "I'll be okav."

Meeker shut the trunk. In pitch darkness seented with rubber and gasoline, Ted curled his gangling frame into a comfortable position. The car moved off.

To his disappointment the noise was inaudible. Soon the sound of jackhammers signaled their return to the Model Garage. Meeker stopped near the pumps, where Stan was putting gas into a car.

"Just leave it," yelled Stan over the racket.

"I'll move it in later."

Meeker nodded, got out with the keys, and, reaching for the door, accidentally banged his hand against its edge instead. The keys flew out of his hand and slid along the apron. Stan picked them up.

Meeker pointed toward the trunk, said something Stan didn't catch, and trudged off. Another car pulled in for a tire change. Stan was just finishing this when Gus returned.

"Seen Ted?" Gus asked as Stan got out of Meeker's car after driving it into the shop. "He drove off with the man who owns this car and didn't come back."

"Strange, Okay, Stan, you finish it."

Stan raised the hood over the running engine. He disconnected one shift link from its arm on the column shaft. The squeak—and an echo of jackhammer pounding—persisted. He replaced the link rod and disconnected the other one.

The rattling squeak ceased.

Stan inspected the arm. The metal ring,

or grommet, that the rod rested in was loose in the arm. With a punch and hammer, Stan collapsed it and drove it out, the sound of his blows echoing strangely. He set in a new rubber grommet and replaced the rod. There was no more squeak.

"That was it," Stan said as Gus came up. "Guess the other shop had a car where the noise was in the column, and thought it was here, too. Hey! Is this bus haunted?"

Gus shut off the engine. A dull pounding remained. The thuds evidently came from the trunk. Stan unlocked it and Ted sat up, blinking.

"So that's what the man

meant!" murmured Stan.

The boy clambered out, "I thought maybe that noise was telegraphed from in back. So I rode the trunk. But it wasn't. Am I fired, Boss?"

"No, but I think you're cured of riding in trunks," answered Gus. "Finding car noises takes common sense, patience, and luck. If you can hear it with the car standing still, as in this case, you ought to know it probably isn't in the shocks, springs, or drave train.

"Engine vibration can kick up a racket, though, from a loose splash pan, clip, tubing, or even sloppy steering joints. You check by looking for such things, holding them tight, or disconnecting them. When the noise quits or even just changes pitch, chances are you've closed in on it."

"I get it, I think," said Ted. "But how come Meeker was so jumpy from a little noise? Bet he has a real quiet job."

"Not exactly," returned Gus. "Mr. Meeker's job is running a jackhammer."



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WITH GENUINE GM CHEVROLET REPLACEMENT PARTS

You should care what parts go into your Chevrolet, because your Chevy does! Take Chevrolet truck drivers, for example. Dependability is what they're after. That's why they're particular about the parts that go into their Chevies. They know that Chevrolet cars and trucks last and last when carefully mainteined with genuine Chevrolet replacement parts that are engineered and built especially for Chevrolets. By being equally particular about the brand of parts that go into your Chevy, you'll be protecting your car investment with the finest care possible. Genuine Chevrolet parts are available at all Chevrolet dealers and leading independent garages and service stations. ... Chevrolet Division of General Motors, Detroit 2, Michigan.



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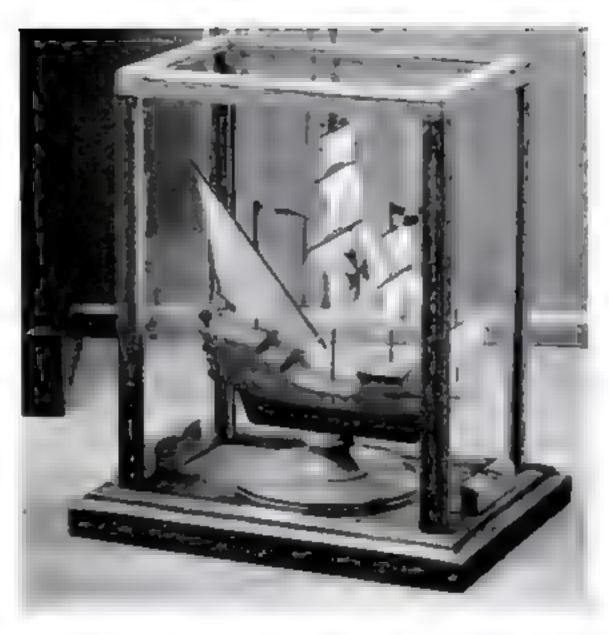
PS winter workshop

Making a glass display case is easy—with epoxy

Epoxy glue makes it easy to construct dustproof display cases for models and other collector's items. Put the glass together with butt joints and reinforce the vertical joints inside with wood strips of square or triangular section. You can omit the reinforcing strips at the top on a small case and just glue the glass top to the sides.

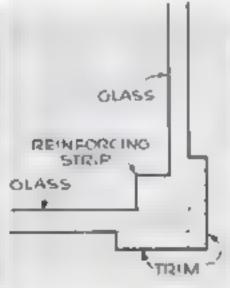
For outside trim, use thin wood strips of veneer or wood ribbon sold as edging. Cut one strip a thickness wider

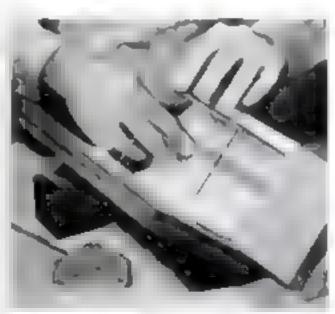
to overlap the other when it's glued in place. Make the recessed base a snug fit,



but not tight if the wood is likely to shrmk.-Walter E. Burton, Akron, Ohio.

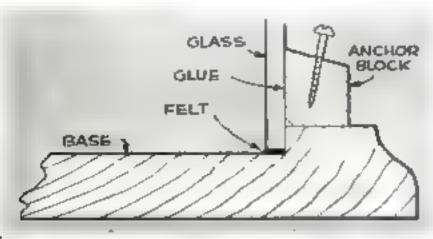






A scrap-lumber trough simplifies assembly of the right-angle glass joints. Here, a wood remforcing strip is being pressed into place.

Halves are joined after the panels have been cemented together, two by two. Paper strips laid down in trough keep glue from sticking



Glass case is inset in routed-out or built-up base and anchored as shown. Felt strips under bottom edges of glass will keep out dust.



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REPAIR FISHING TACKLE. Bond metal to fiberglass on your favorite fly rod with Weldwood® Epoxy glue. Seal oil or gas lines on your outboard. Bond almost any material, Supports tons—waterproof.



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MOUNT YOUR SUMMER SNAPSHOTS with Weldwood Presto-Set® Glue, It's quick and clean. Dries fast, and won't stain, In bellows-action squeeze bottle with spreader top.

You can never tell when you'll have an hour or two to catch up on the projects you've planned. So be ready with the materials you'll need. Pick them up on your next shopping trip—a full selection of Weldwood finishing materials—Deep Finish Firzite and White Firzite® and Satinlac®. They're available at your local lumber yard and at paint and hardware stores.



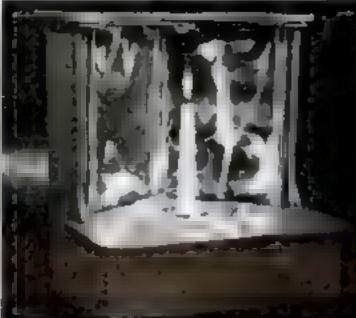
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PS winter workshop

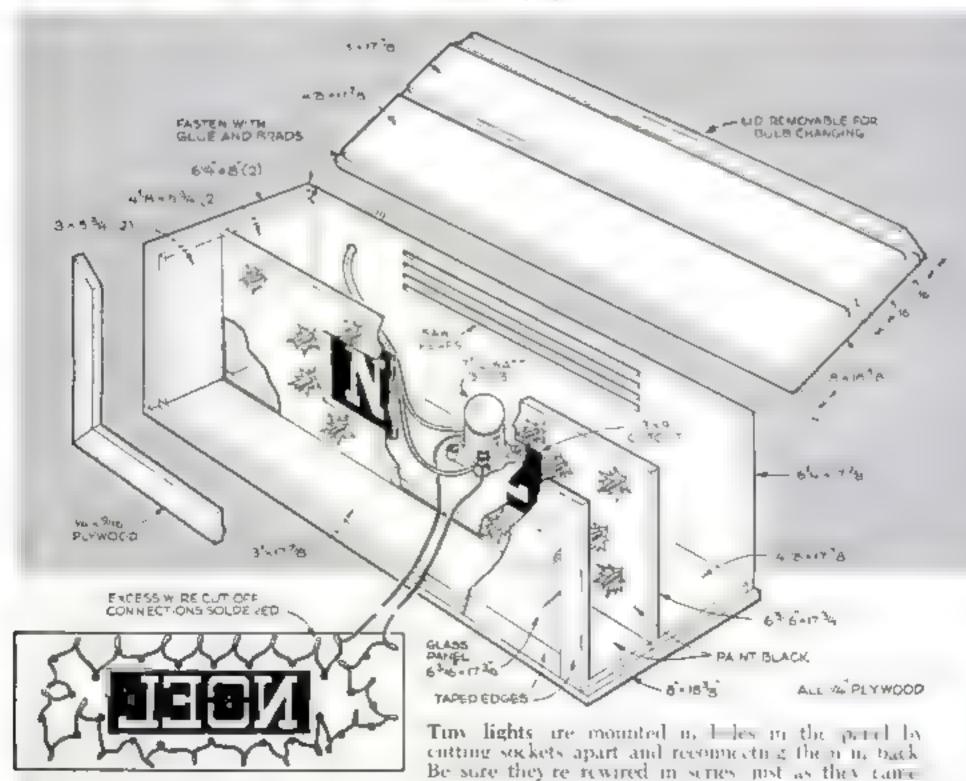
Holiday fun with new "rainbow" plastic:

Two Colorful Lights for Christmas





See these unusual decorations in full color on page 135



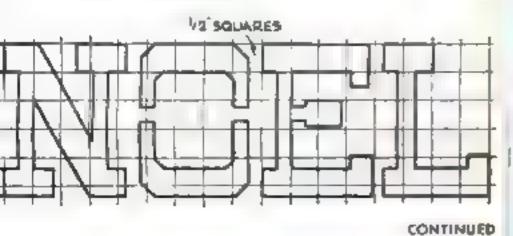
TE POPULAR SCIENCE NOVEMBER 1962

THE sparkling Christmas decorations shown in full color on page 135 are two examples of the exciting fun you can have with a new grooved-plastic diffraction grating that changes white light into dazzling rainbow hues. Shine a light through a piece of the plastic, and the rays spread out across the grooves in two multicolored spikes. Place a second layer on top with the grooves running at right angles, and two more rainbow spikes crisscross the first, forming a four-pointed star, Add another layer with the grooves running diagonally, and you get a six-pointed star. Add still another laver with the grooves diagonally in the opposite direction, and von get an eight-pointed star.

This is the principle used in the colorful star box shown at left. A string of miniature Christmas lights, mounted behind four layers of the grating, produces a whole galaxy of glittering eight-pointed stars. The candle stand, shown here and on the following page, uses a reflective grating that bounces shimmering rumbows from the candle and a light bulb shining up through slots in the base. Only one layer is used since light can't shine through the reflective type.

But these two projects are only starters. The grating can be used in many ways for both entertainment and serious study. You can make spinning pinwheels, mobiles, spectroscope viewers, and setups for projecting the colors onto a screen or will. In a microscope, the grating becomes a precise measuring scale and a tool for determining the refractive index of crystals. For some fascinating photographic surprises, try shooting color film with layers of grating taped over the lens.

For additional experiments, a booklet is available for 50 cents from Edmund Scientific Co., Barrington, N.J. The grating itself is also available from Edmund in two sizes. For the transmission type—the kind you look through—an 8"-by-11" sheet costs \$1.50 and an 8"-by-6' roll \$5.95. The reflective type comes in the same sizes for \$2.50 and \$10.95 respectively.



ANT

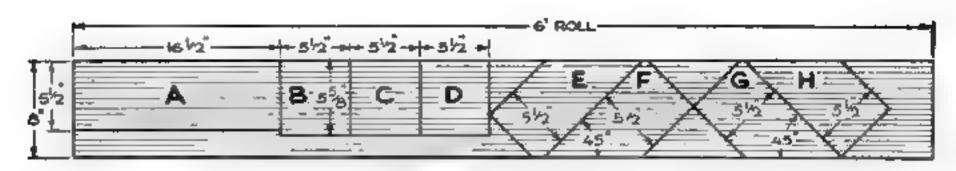
Don't miss this saw spectacular! Spend a few minutes with the next five pages... compare prices, sizes, capacities. Read about big savings and special offers you can get.

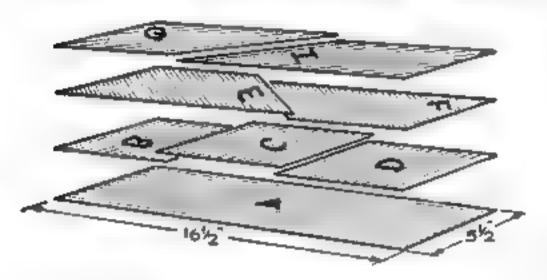
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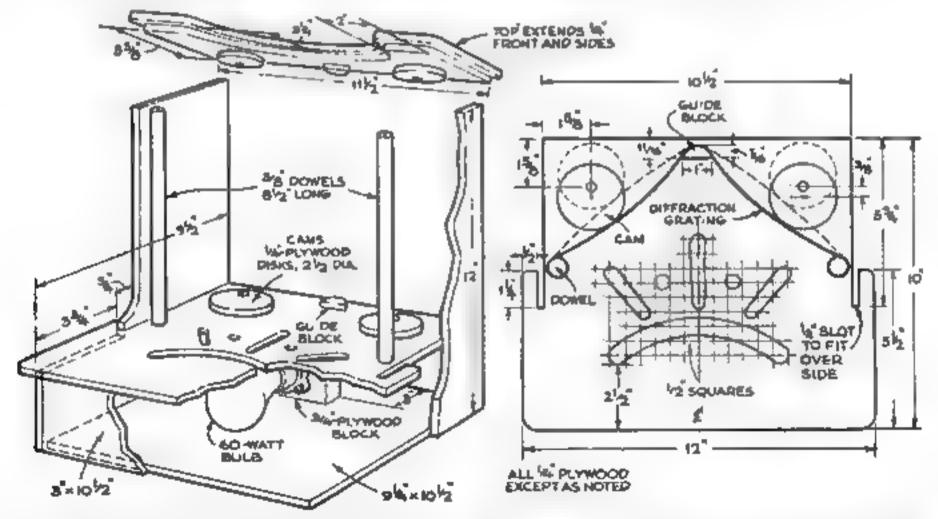
Cutting pattern for the star box shows how you can get four layers of plastic grating from one 6' roll. Note that pieces, after cutting, must be turned so their grooves run in the same direction in each layer, but in a total of four different directions in the four layers. The layers will be slightly smaller all around than the hox's opening. Sandwich them, centered, between two sheets of glass that match the opening size and bind the edges with black tape.

Making the star box. Grooves for holding the grating and the light panel behind it are built up with plywood spacers, making construction simple. A rectangular cutout in the light panel provides an opening for the back-highted word NOEL.

Cut the stenciled letters out of cardboard according to the squared pattern. The stencil is covered with a strip of white translucent material on the back and taped behind the panel's cutout. The translucent material can be ordinary tracing paper, frosted acetate or glass, artist's vellum, or, in a pinch, plain white paper.

The miniature star-producing bulbs are available in strings of 20 for less than \$2. It's important to use white bulbs to get pure rainbow colors. Generally you can find all-white strings; if you can't, replace the colored bulbs on your string with white ones. For an especially eye-catching effect, try a string of twinkle lights—the kind that wink on and off at random.

Follow the cutting guide in order to get the four layers of grating from a single 6' roll. The candle stand uses two 8"-by-11" reflective sheets taped together at the back to avoid cutting a full roll.



Candle stand has a backdrop of reflective-type grating held in a V shape by guide blocks and two dowels. Tape ends of grating to dowels and roll them up to vary length. Dowels turn

stiffly on partially tightened screws. Cam disks, pivoted off center, let you vary the grating's shape, as at right, to change color patterns. Place candle 2" to 5" from backdrop.

So you want to buy a BAYONET SAW



SPECIFICATIONS

(Model 300 Bayonet Saw)

Blade Stroke	1/16"
Cutting Capacity	Wood 21/2"
	Aluminum 3/4"
	Steel 3/16"
Motor	2.5 amps
Speed	4000 spm
Net Weight	
Length	

Here's a new PORTER-CABLE saw that's unequalled in sawing flexibility... actually the fastest cutting saw of its type. It has preferred orbital blade action and is powered by a failure-proof motor guaranteed for two years! And it cuts almost anything—ferrous and non-ferrous metals, all woods, compositions and plastics. You'll do everything from inside curve cutting without a starting hole to big capacity straight line cutting jobs. All in all, a honey of a value.

Own it today. See your PORTER-CABLE dealer.



130-foot, 60-knot hydrofoil ship carrying 230 passengers. (It could seat 310, but with less elbow room.) The scenic 189nautical-mile run would take 34 hours and the round-trip fare could be \$30. That compares with a 50-minute plane ride each way, at a tourist round-trip rate of \$33-but it would also save the time and cab fare to outlying airports. The hydrofoil route's attractions, concludes the study, would daily draw 130 travelers in each direction who would otherwise go by air; and 80 more, each way, who would go by cruise ship or not at all. How near to the mark these predictions may be, the Denison should help to show.

For the Navy: a hydrofoil warship. Meanwhile the second seagoing U. S. hydrofoil, launched last August, will pioneer the naval use of big foilborne vessels. Built for the Navy by the Boeing Company, the 110-ton sub chaser High Point will be our first hydrofoil warship-an ocean-going fighting craft, armed and ready for combat. Due for trials after several months' fitting-out in a Tacoma shipyard, this 115-footer is expected to attain 40 to 50 knots-considered ample for its mission-under the total 6,200 hp. of two gas turbines. The High Point's foils, like the Denison's, have autopilot-controlled movable flaps -but their advanced, totally submerged design goes even farther from precedent.

Already under way is a still bigger naval hydrofoil—a 300-ton research vessel more than 200 feet long that Grumman will build for the Navy. Two huge gas turbines, rated at 18,000 hp. each, are to drive it on totally submerged foils at about 45 knots.

Thus the U. S., after a long-delayed start, has stepped into world leadership in developing hydrofoils.

For many years the winged craft have been plying the lakes, rivers, and inland seas of Europe. Russia has built the biggest in use to date—a 300-passenger craft of 107 tons called the Sputnik, propelled by four diesels that turn out a total 3,600 horsepower at about 40 knots.

None of these European craft, however, are intended for the high seas. They fly on fixed U- or V-shaped "surface-piercing" foils, a simple and time-tested type ideal for smooth inland waters. Because such a foil's lift increases as it dips deeper, a craft so equipped is self-righting—and stays as level as the water's flat surface. For the same reason, though, a fixed-foil craft would faithfully follow the ups and downs of ocean waves, in an undulating, "contourflying" course that would become bumpy and dangerous at high speed.

That is why seagoing hydrofoils have awaited the movable, autopilot-controlled foils that U. S. designers have built into the Denison and High Point.

Major American contributions to hydrofoil technology do not stop there Another has been the adaptation of powerful aircraft-type gas turbines.

Beating the bubble problem. And probably the biggest U. S. breakthrough, still to be fully exploited, has been the discovery of specially curved profiles that enable propeller blades and foils to whiz through water at unheard-of speed—without prohibitive damage from a destructive, exploding-air-bubble effect called cavitation.

Already this discovery has yielded high-speed "supercavitating" propellers like the Denison's, which, at 60-knot speed, churns the water at 2,670 r.p.m.

More exciting will be its application to foils—of which "supercavitating" types are being intensively developed for future installation on the Denison, the High Point, and coming ships-on-wings. On a swinging pendulum, trial models for the Denison have been slashing through a tankful of water at Dynamics Developments, Inc., an affiliate of Grumman, under a \$428,000 Marad contract.

Experts at Grumman confidently predict that a set of the new-type foils will boost the Denison's present 60-knot speed to a fantastic 90 knots, or more than 100 m.p.h.

So you want to buy a PORTABLE SAW



SPECIFICATIONS

(Model 170 Portable Saw)

Blade diameter7"
Depth of Cut, 90° 21/2"
Depth of Cut, 45°2"
Motor 10 amps
Idle Speed 4500 rpm
Net Weight 93/4 lbs.
Length

This PORTER-CABLE saw is the fastest-cutting 7" saw made . . . and it's yours now at a big \$10.00 savings. It whizzes through stock a full 2½" thick. You'll find it powerful, superbly balanced, safe and convenient for all types of cutting. And you'll like these Porter-Cable quality features: Kick-Proof Clutch, Built-in Blade Lock, Trigger Switch with Lock Button, Telescoping Guard, Single Line of Cut and Wide Wrap-around Base, Why wait?

Own it today. See your PORTER-CABLE dealer.



A high-speed ram. A third highenergy technique forms metals with a pneumatic-mechanical machine. At one stroke a high-speed ram, propelled by a near-explosive release of compressed gas, produces a part that would normally take several passes or hammer strokes, with reheats in between.

One die, on the moving ram, is driven against a workpiece inserted in a second die. The ram's high velocity creates sudden, tremendous pressure. Hit by it, tough, hard, or brittle metals become plastic. They flow smoothly and evenly into every die opening

Typical is the vertical Dynapak machine, built by General Dynamics' Advanced Products Department. It delivers a punch of as much as 431,000 foot pounds of energy, comparable to the impact of a one-ton weight falling 18 stories—and moves metal 100 times as fast as conventional presses do.

Triggering this machine breaks a seal and allows high-pressure nitrogen gas to spurt into a cylinder, driving a piston and the ram downward as fast as 85 m.p.h. Simultaneously the heavier cylinder moves upward like a recoiling gun, minimizing the jolt transmitted to the flooring. After the machine is "fired," a hydraulic pump recompresses the nitrogen to recock it. It's almost like a rifle in its "cock, fire, recock" cycle.

Machines of this type easily forge, extrude, compact, and stamp metals that are hard to shape by conventional technique. Besides carbon and stainless steels, copper, and aluminum, they handle metals that until lately have been difficult or impossible to work: tungsten, molybdenum, titanium, columbium, zirconium.

Shaping with magnetism. The latest high-energy metalworking device wields an ultra-powerful magnetic field.

To do this, electrical energy is stored in a bank of condensers and suddenly released through a coil, in a lightningfast pulse lasting 10 to 20 millionths of a second. Momentarily the coil becomes a magnet with a field as powerful as 300,000 gauss—a toplofty figure formerly reached only in leading research laboratories. In a nearby workpiece of conducting material, the mighty magnet induces an electric current with a magnetic field of its own. Interaction of the two invisible fields exerts a pressure on the workpiece of more than 500,000 pounds per square inch.

Which way the force acts depends on the placing of coil and workpiece. A coil surrounding the workpiece compresses it—to swage sections of tubing firmly together, or to attach terminal connections to rope or steel cables. A coil within the workpiece stretches it expanding tubing to form a tight-fitting

bearing, hub, or bushing.

Said to be the first of this kind to be introduced for industrial use is the Magneform machine made by General Dynamics' General Atomic Division. Housed in a small console taking up only eight square feet of floor space, it uses conventional 220-volt, 60-cycle power. Interchangeable coils adapt it in rapid succession for swaging, expanding, and forming or shearing, dimpling, blanking, embossing, and coining.

Such an electromagnetic forming machine has no moving parts. It avoids damage to a surface by scratching or marring, since there is no physical contact between coil and workpiece.

Ferrous metals are not the only ones that can be worked magnetically; aluminum, brass, copper, and molybdenum have been successfully formed. Wrap a material of lower conductivity—like stainless—in a thin sheet of copper or aluminum, and it becomes amenable to the magnetic technique, too.

Only a start has been made in exploring the applications of these new highenergy ways of metalworking. Successful when conventional methods fail, they promise new freedom for design and production engineers. Already they're helping American industry to create better products more cheaply.

So you want to buy a COMPACT SAW



(suggested retail)

SPECIFICATIONS

(Model 34-200 COMPACTOOL Circular Saw)

Blade diameter71/4"				
Diameter of Arbor				
Depth of Cut, 90°111/16"				
Depth of Cut, 45° 13/4"				
Speed3450 rpm				
Rip capacity with extension				
wings , center of 201/2" board				

Overall dimensions: Depth 17" Width 13" Height 171/2"

The COMPACTOOL saw gives you "hig tool" accuracy, versatility—goes anywhere. If you're itching to do projects your portable can't handle—but feel you can't afford to step up to a heavier, stationary saw—this is for youl Lightweight, easy to take to the job—easy to store away. And you'll like the smooth, quiet power the revolutionary, built-in motor delivers. A demonstration can be mighty convincing. (There's also a COMPACTOOL Jointer and Drill Press.)

Own it today. See your COMPACTOOL dealer



scientists believe the instrument is the most important addition to an already impressive and growing collection at the Kitt Peak National Observatory. Only four years old, the Kitt Peak observatory is the first in the U. S. to be built from scratch since California's Mt. Palomar was completed in 1948.

Paid for out of taxes and staffed by astronomers from nine universities—California, Chicago, Harvard, Indiana, Michigan, Ohio State, Princeton, Wisconsin, and Yale—the observatory is in a fine position to view the heavens. It's above ground haze, free from smog, and cut

off from city lights.

Fine once you're there. Getting there has not been half the fun. Kitt Peak thrusts up out of the reddish-brown Sonora Desert 45 miles from Tucson. The 6,770-foot summit is a rough triangle, each side a half-mile long. The peak rises nearly 4,000 feet above the desert, where dust devils twist through the sagebrush in swirling sun-heated air.

Designers were beset with problems. For the solar telescope in particular there were two: housing and heat.

The "long eye," as the local Papago Indians call it, needed an exceptionally strong housing. It has. Its frame is a 10-story-tall tower that can hold the telescope steady even in a gale. The tower is rooted 30 feet deep in grante. Its concrete walls are nearly three feet thick. A 35-mile wind couldn't budge it more than a thousandth of an inch.

The heat problem. An instrument whose sole purpose is to catch and focus the sun's rays quite naturally has to cope with fiery intensities, not only at the top but all along its tenth-of-a-mile tunnel.

Both telescope and tower are painted gleaming white to repel as much heat as possible and help shield the telescope's view from distortion. A special paint developed from a military formula, using titanium oxide as its reflecting material, can unload about 85 percent of the exterior heat.

Getting rid of the rest, plus the in-

ternal heat created by the sun's rays inside the tunnel, was the tricky job. It was done by covering the entire outside with panels containing copper tubing. The panels sop up the heat, and the half-inch tubes, spaced about every six inches, permit a coolant to carry the heat away. Some 25,000 gallons of ethylene glycol is kept constantly circulating.

When will it be ready? The solar telescope, dedicated Nov. 2, and several new stellar telescopes, should be probing the skies by Christmas. Construction activities have gotten a boost from a new highway that puts Tueson only an hour and 20 minutes from the peak.

When work on the observatory began, in 1958, the route to the summit was a tractor trail with appallingly steep grades. A road was then cut to enable heavy machinery and loads to reach the top. Even this had an 18-percent tilt in places. Cargoes sometimes overturned into ravines. That's over now.

A pleasant scientific community has formed at the top of the peak. A dining room feeds from 25 to 40 persons a day, including some of the brightest names in astronomy. The visiting researchers have quarters in a neat dormitory. Their water supply comes from a two-acre catch basin, a huge funnel to trap rain.

By day, the view from the summit is immense and stark, a panorama of desolation. By night, the black earth merely accentuates the vast, blazing display of stars above it. Tucson is only a faint, eastern glow in the darkness below.

The silvery domes of four stellar telescopes—two 16-inch, one 36-inch, one 54-inch (not yet in use)—already crown Kitt Peak. New ones will include the University of Arizona's 36-inch telescope—to be moved there to avoid the haze and lights of Tucson. Future plans for Kitt Peak also call for a 160-inch telescope, a close rival to Palomar, and eventually one even larger.

Right now, however, the immense new solar telescope dominates the scene and commands the world's attention.

So you want to buy a BENCH SAW



SPECIFICATIONS

(Model 34-600 Delta 9" Saw)

Overall dimensions: Depth 36" Width 371/2" Height 171/2"

Buy the fumous DELTA 9" Tilting Arbor Saic—get the stand FREE. If you act now, you'll get a sturdy steel stand (a \$22.00 value) as a bonus for choosing a tool that's really "loaded." It has the power, precision and capacity to satisfy the most exacting users. It's the saw with truly industrial quality and performance at a home workshop price. The offer is limited—take advantage of it!

Own it today. See your DELTA dealer.

*Slightly higher in the West.



[Continued from page 79]

In the Knowles case the doctors didn't have to resort to a graft because of a complication in the injury itself. They had had to remove an inch of bone that was too shattered to repair. While this means that the arm will always lack an inch in length, it gave them a chance to remove any doubtful-looking tissue at the severed points and have enough left to link good tissue with good tissue.

Dr. Shaw rejoined two of the brachial veins with 20 to 30 dacron sutures taken around the circumferences of the veins. The

brachial artery was next.

The delicate job took time. The artery and veins were only about one-sixth of an inch thick. It was now six o'clock, two hours since the operation had begun. Clamps were purching back the blood supply in Everett's body above the severed area.

Tension showed in the surgeons' brows, damp with the sweat of work and worry. Finally the moment had come. No one of the 20-odd people in O.R. 5 or the gallery above spoke—or even breathed—as Dr. Malt gave the order to unclamp the vessels. Almost immediately, the arm, still blue-white and cold—a corpse-like extremity—began to warm and turn pink, suffused by the fresh blood pumped in from the boy's heart. The doctors felt for—and found—a pulse beating.

The doctors glanced up from the table and exchanged looks of thanks. Beneath his mask Dr. Shaw smiled. The first phase of

the operation was a success.

humerus. It had been broken off two or three inches below the shoulder joint. One surgeon described the bone ends as looking as if the arm had been laid on a bar and whacked with a sledge into splintery fragments.

These fragments had been removed, along with bits of bieless skin and muscle.

Now infinite pain would have to be taken in setting the bone for fear of rupturing the rejoined blood vessels. Dr. Malt decided that a clover-shaped length of steel tubing would be the best means of nailing the bone together. This odd-shaped "Küntscher" nail would provide a three-point contact to prevent the bone from rotating and give it the stability it needed. At the same time, it would not impair the blood supply. The exact length needed—6% inches

-had been measured, and Dr. Leape sawed off a length of rod with a sterile hacksaw. The rod was held in a vise placed on the corner of an instrument table and anchored there by a nurse.

Dr. Malt now drove the nail through the marrow cavity of the stump bone, using a sterile mallet. Then, while Dr. Leape held the arm in place, orthopedic surgeon Mitchell forced the severed arm on to the free end of the nail. Using his hands alone, he applied pressure from the elbow area.

The time was now 9.00. The bone surgery had taken almost three hours. There was still the mangled left hand to worry about. But first another vital lifeline had to be considered: the nerves. Would the chief surgeons around the table attempt the tricky business of nerve grafts now? The procedure was time-consuming.

Three main bundles of them in the arm had to be reconnected. There are myriad fine fibers in these, covered by protective sheaths, that trail down to the fingertips in one direction, track back to the brain or

spinal cord in the other.

How could the surgeons tell how much damage had been done? If the boy had been thrown from a train he might well have sustained some nerve injury back toward the spinal cord. Then no amount of stitching at the point where the nerves were broken would restore feeling to the arm.

The decision was up to Dr. Malt. The boy had been under anesthesia for more than five hours. He had received six pints of blood, four more in addition to the emergency-room transfusions. Malt shook his head. It would be better to postpone the nerve grafts, Instead they would join the outer sheaths of the nerves with heavy dacron sutures. They would then be easy to identify at a later operation.

Now the basic surgery of reconnection was finished. But there was still work to be done. One task was to remove fatally damaged areas of tissue. Usually this "debriding" is done at the outset, and indeed some lifeless tissue had already been cleared away. But the unique quality of the arm operation determined a different logic: The major debriding would have to wait until they had restored circulation. Then the surgeons could see which tissue would have an adequate blood supply.

So you want to buy a RADIAL SAW

\$25900

(stand extra)



Meet the DELTA Super 990 9" Radial Saw—a versatile one-tool workshop. Rip, cross cut, miter, bevel, dado, shape, drill, sand . . . you name it, this workshop workhorse does it! You get horsepower that backs up cutting power. And you get useful features like the new built-in brake, exclusive "Turret Arm" action, Micro-Set Stops and new double-shaft motor. These are some of the reasons you get more for your money with the Super 990. Ready for a Radial?

SPECIFICATIONS

(Super 990 Radial Saw)

Blade diameter9"				
Diameter of arbor				
(rear shaft)**"				
Depth of Cut, 90° 2½"				
Depth of Cut, 45° 1 1/4"				
Speed (full load) 3450 rpm				
Rip Capacity				
center of 48" panel				
Overall dimensions: Depth 27"				

Own it today. See your DELTA dealer.

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The Boy Who Lost His Arm-and Got It Back

After this there was the task of rejoining the soft tissue across the break, the complex layers of muscle and tendon and the sheltering envelope of skin. Dr. Malt carefully sutured the layers. But some skin was missing, and more was irreparable. Two areas—one behind the armpit, one over the shoulder in back—had to be left raw.

Again the decision was to wait, in this case for only a few days. Then if infection had been avoided and healing begun, they would graft skin from other parts of the boy's body to cover the exposed places. The surgeons placed sterile dressings over the sites, and under the supervision of Dr. Mitchell a large plaster cast called a "spica" was fitted to the boy.

Dr. Malt now felt that O.R. 5 had outlived its usefulness and might even be a source of infection were they to continue there with the second operation on Everett's hand. So, still in deep sleep, the boy was wheeled from O.R. 5 into the corridor and down the hall to O.R. 6.

The mangled fingers and thumb of Everett's left hand were cleaned, and skin grafts applied. These were thick split-thickness grafts—sections of skin that include most but not all the layers of tissue. Grafts were taken from Everett's right foot.

When these grafts had been completed by Dr. Leape the second operation was over. The total time for surgery had been eight hours. The boy had been anesthetized for 8% hours.

He was moved now to one of the narrow railed beds used in the recovery room. There a staff of nurses in surgical gowns tend post-operative patients, watching the "vital signs" of blood pressure, pulse, and respiration. Shelves along the walls of the room are lined with plugs or attachments for whatever solutions or equipment a surgeon may order for his patient. Soft music plays in the room all day long. (One doctor calls it the "tranquilizer waltz.")

Everett stayed in the recovery room over 24 hours. Head Nurse Polly Jacques' report by this time sounded familiar: The boy was conscious soon after the operation. He was calm and cooperative.

EVERETT'S next move was to the isolation floor on White 12. This was a measure to protect him. The rooms there are screened to keep out flies. Inside each room there is a foot-pedal sink and laun-

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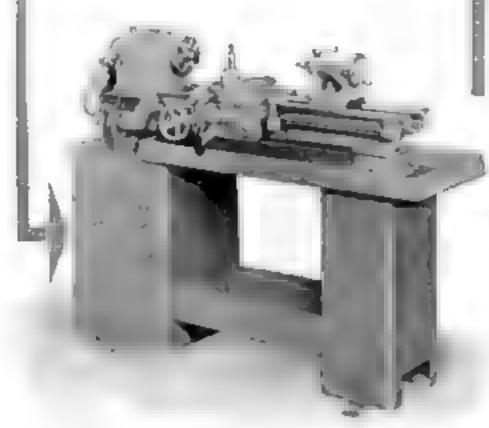
Go see your dealer now for a look at the spanking new Harley-Davidson line. You'll find a set of wheels to take you wherever you want to go, to wonderfully widen your fun horizons! Now at your dealer . . . new, free full-color literature . . . easy-pay terms . . . help in getting insurance . . . and the great Harley-Davidson get-up-andgo line for '63 . . . Duo-GLIDE, SPORTSTER H, SPORTSTER CH, SPRINT, SPRINT H, PACER, SCAT, TOPPER H. See the Yellow Pages under "Motorcycles" and "Scooters" for the name of your Harley-Davidson dealer.

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Time payment plan available. Up to 36 months to pay.



The Boy Who Lost His Arm—and Got It Back dry-disposal unit. Outside, there is a row of plaques stating the precautions visitors were to take. Everett's visitors got the works: Anyone seeing him had to wash up first, then wear a surgical gown and mask.

Five days after the operation Everett was taken down to the operating floor again. The cast was removed. Happily, the wound looked the way the doctors hoped it would. The raw areas were ready to receive skin grafts. The boy was readied for surgery again and anesthetized. Again splitthickness grafts were used, this time taken from the right thigh. In a few days they were checked and found to be growing.

On June 13—exactly three weeks to the day Everett came into the hospital—he was

discharged.

But the story wasn't over.

The boy now had an arm firmly rejoined to his body. But the arm had no feeling in it. It lay in a east. Every day the muscles of his fingers had to be exercised. Daily he had to come to the physiotherapy department of the hospital at that his forearm muscles could be stimulated electrically. They could not be allowed to grow slack.

On Sept. 11, the doctors went ahead with the crucial nerve surgery. In a 6%-hour operation they rejoined the median, radial, and ulnar nerves which had been loosely sutured originally, plus one more, the musculocutaneous. Much scar tissue had to be removed. In two of the nerves the shearing off was so extensive that tissue grafts from the boy's upper arm and left hip had to be taken to fill the gaps.

Now the doctors face a long waiting period—at least six months—before they know if they have succeeded. Nerves grow

that slowly.

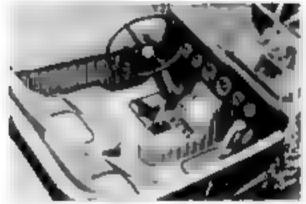
The doctors have no idea how much nerve regeneration there may be. So they are cautious—but optimistic. The boy is young. The healing, regenerative, and adaptive powers of young people are better than those of adults.

The doctors feel that Everett will be able to use his arm "enough to gain his livelihood." The arm may lack some fine sensitivity but it will be a useful one. One that

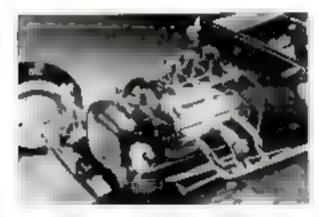
can pick up objects, grasp things.

So while no one is jubilant, there is guarded hope. The surgeons do not congratulate themselves on a breakthrough. They merely combined a number of complex and radical steps m one long operation.





Extra Ports for Interior Variety. This interior has canter console. Corvette shift lever, telephone. radio. TV. Stewart-Warner Instruments, overhanging clutch and brake padats, custom carpet and simulated Haug abyde sides.



Choice of Radiator Shalls and Grill. Make your Big "T" with chopped "24 or "32 Ford shell and with Ford radiator or custom grill. Two shells, radiator and grill included in kit.

AUTHENTIC 1½ INCH SCALE ALL-PLASTIC MODEL Steer It! Motorize It! Extra Custom and Show Parts

For home shop or kitchen table assembly—the Big "T" is magnificent fun. Big 1½ inch scale and amazing detail provide model building enjoyment in an entirely new dimension. This Monogram Street and Show Pick-Up model is built around the prized '24 Ford Roadster body and is customized with parts scaled from ten other cars and loads of special custom goodies. One-eighth real car size.

You make the Big "I" in the best customizing tradition—as you like it best—with choice of interiors and

front end. There's a custom 283 Chevrolet engine with three carburators and all the trimmings, soft phable and realistic tires and slicks, bucket seats, tools, trophy and "show" accessories. Model steers like a real car and can be motorized for electrical operation with \$1.49 power kit

Big deluxe kit contains 203 precisionmolded parts in 5 colors of plastic, 97 of the parts are in gleaming chrome plate. No painting required, 24-page assembly guide with 106 pictures makes assembly easy

Get the Big "T" at Hobby Shops and Other Stores

For the time of your life and a beautiful show piece, get the Big "T" let at hobby shops and other stores in your neighborhood. Watch for the Monogram display with the Big "T" in a "show setting." Don't accept a copy or substitute. Ask for it by name—the Big "T" by Monogram.

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NOW YOU CAN increase the boring range of your small electric drill or drill press. New Irwin Speedbor "88" bits bore faster, cleaner holes up to 1½" in any wood. ¼" shank chucks perfectly. No wobble, no run-out. Sharp cutting edges on Irwin exclusive hollow ground point start holes faster, permit spade-type catters to hore up to 5 times faster. All Irwin Speedbor "88" wood bits are forged from single bar of apecial bit steel, tempered foil length and machine-sharpened for extra accuracy, longest life. 17 sizes, ½" to 1½". Buy individually or in sets from your Irwin hardware or building supply dealer.

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The Boy Who Lost His Arm—and Got It Back

All the techniques had been tried separately on other occasions.

But they have learned much from this experience and expect to learn more. They are grateful for the competence and quick thinking that characterized every role in the story. They are grateful to the emergency-ward staff. To the ambulance drivers. To the police. To Norman Woodside. And to Mrs. Chmielewski.

So is Everett.

Background on an Age-Old Dream

Doctors have been sewing back lopped-off fingertips for years. Or parts of noses and ears. But never had they succeeded with whole limbs—arms or legs—in humans.

The idea is, of course, an old one, a dream that men have tried to make come true for centuries. Only recently have there been successes—and these have been on animals. Dr. Chfford C. Snyder of the University of Miami has amputated and then re-implanted the forelegs of greyhounds. Other experimenters have transplanted major extremities between animals. Here success is measured in survival times: How long does circulation and normal metabolism persist before the animal rejects the foreign tissue? As early as 1908 an American, Dr. Charles C. Guthrie, managed the extraordinary feat of transplanting a second head onto the neck of a dog

In 1959 Russian scientists repeated Guthrie's two-headed dog experiment, this time using a specially developed blood-vessel stitching machine that joins tissue

with fine platinum staples.

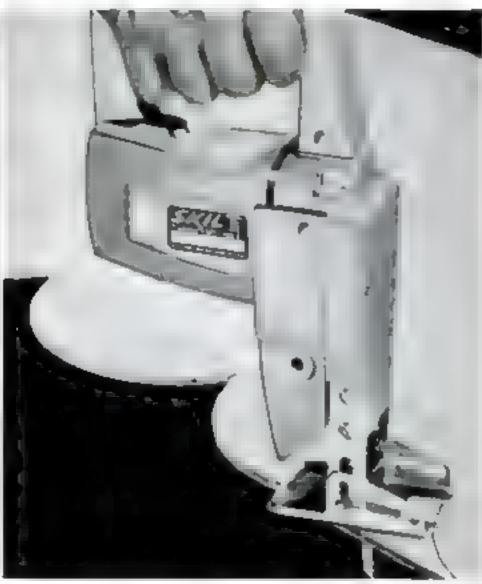
But these successes have come from planned, carefully controlled experiments in the lab. Not until the Knowles case has a hospital reported the successful re-implantation of a major limb following a

complete amputation.

Strangely enough—whether by coincidence or inspiration—a number of hospitals have since reported similar operations. At Sharp Memorial Hospital in San Diego, Calif., the hand of a punch-press victim was sewn back on. A hand operation was also performed at Chicago's Presbyterian-St. Luke Hospital on a bindery worker. In Calgary, Alberta, a 17-year-old girl whose arm was all but severed in a fall underwent surgery remarkably similar to the Everett Knowles operation. And finally, again at Massachusetts General, the attempt was made to re-implant the foot of a motorcyclist. In all but the last case the operations appear to have been successful so far.

NEW KIND OF POWER SAW



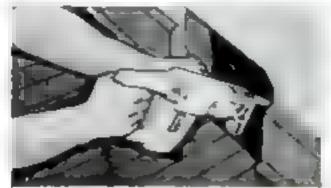


Skil Recipro Saw makes any cut from 6" fence posts to fancy patterns!

The Skil Model 577 Recipro Saw is the first portable power saw with almost unlimited cutting capacity! It'll cut thin sheeting or thick wooden posts . . . or steel pipe, sheet metal, aluminum, plaster, wall board, plastic laminates, you name it!

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WATCH PRO FOOTBALL HIGHLIGHTS SPONSORED BY SKIL ON MBC-TV, EVERY SATURDAY AFTERNOON, SEPT. 22-DEC. 22

Act Now-Boat Earlier [Continued from page 118]

that you are in the minority. So the danger of becoming the front half of a rear-end collision is great and becoming greater. One way to help avoid this fate when you are towing a boat trailer at night is to make sure there's plenty of bright red showing to the rear. What you need are high-level warning lights.

Normal trailer lights, while generally large and bright, are located too low and often too far forward under the hull of the boat. Speeders who can't even see highway signs are not likely to be on the lookout for your partly hidden tail lights.

Put some up high, where even the most reckless driver zooming up on you can't miss them. There are two ways to accomplish this.

One is to construct a simple crossbar that can be attached across the gunwales of your boat, near the transom. Have at least two large-lens tail lights on the bar and run both power and ground wires to them.

Another way is to mount two batterypowered tail lights on a similar crossbar. Actually, a combination of these two is a good idea, since you will then be assured of high-level lights even if there is a malfunction in your car-to-trailer wiring



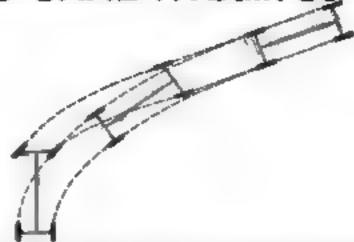
New RDF with long-wave band. Only one thing is more important to a boatman than knowing where the fish are biting. That's knowing what the weather

is going to be at any moment.

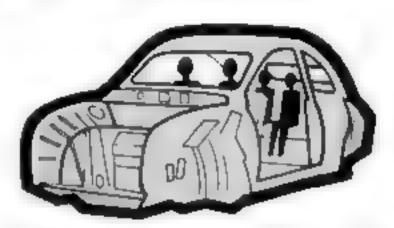
Short of becoming a real-life weather expert yourself, the best way I've seen to keep track of the weather is to listen to the aviation weather broadcasts.

These are issued from every major airport, and tell you in clear language what the weather is for an area of nearly 300 miles in all directions from the airport city. In the larger cities, these broadcasts are taped and are on the air continuously, 24 hours a day. At smaller airports they are not taped, but are broadcast twice every hour—at 15 minutes before and after the hour,

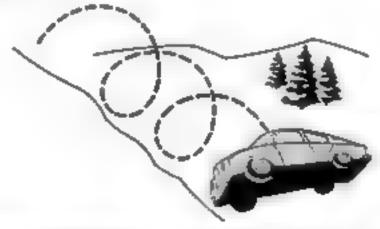
One good way to receive these, and the way I plan to do so, is to use a radio direc-



SAAB FRONT WHEEL DRIVE, carefully calculated understeering, low center of gravity, and advanced suspension design work together to optimize roadholding ability and safety in motion. Self-centering action of directly driven front wheels (see diagram) provides best possible roadholding ability at high speeds. Positive traction of front wheel drive at lower speeds makes cornering easier, dangerous skids virtually impossible. Front wheel drive pulls SAAB safely—on any road, at any speed, through ice, snow, and mud.

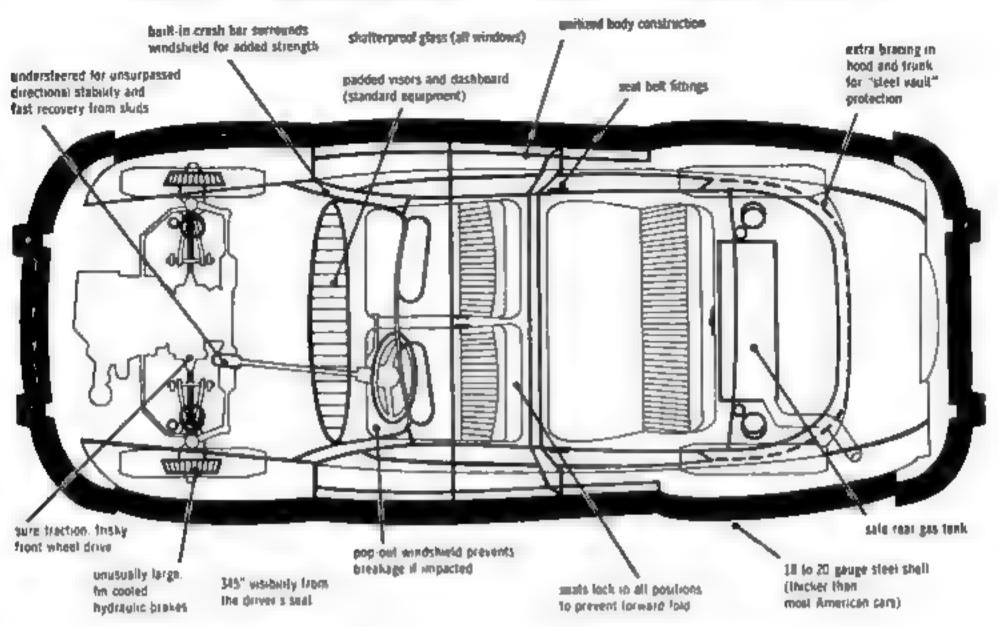


SAAB BODY SHELL is engineered to encase driver and passengers in a practically uncrushable steel airfoil on wheels. SAAB is unitized for rigidity. 18- to 20-gauge steel (heavier than most American cars) is used throughout. Additional steel members, 1/4 inch thick, brace trunk and engine compartments. A crash bar, usually a racing car exclusive, surrounds the windshield for tremendous extra strength—where you need it most. Result: SAAB is as safe or safer than most large cars.



SAAB HAS BEEN SAFETY TESTED the hard way. It was rolled down Scandinavian ski slopes. Its basic over-all reliability has been proved in laboratory tests which simulate the roughest driving imaginable. Purpose: to make SAAB one of the safest cars you can drive. On the basis of test results, for example, SAAB provides as standard equipment such safety extras as: collapsible steering wheel, safety-padded dashboard and visors, positive locking seats, shatterproof glass in every window, and safety belt attachments.

that it has a 24,000-mile/24-month written warranty*



Take a critical look at SAAB safety

Aircraft reliability and performance standards are blended with an entirely new approach to over-all automotive design in the Swedish SAAB 96. This car was built to be better and safer, not different... built by one of Europe's leading aircraft manufacturers... built

for those who enjoy mechanical excellence, technical uniqueness, and extraordinary craftsmanship.

A critical look at all the facts and specifications will prove that SAAB is unquestionably one of the world's best engineered cars.

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\$1895 P.O.E. (little enough for one of the world's best engineered cars)

tion-finder set that operates on three bands—short wave, long wave, and broadcast band. Aviation weather broadcasts are in the long-wave band.

You can find the frequency of the airports of interest to you by checking an avantion sectional chart, or making a phone

call to the nearest airport.

One caution: Get a good set. They are available ready-assembled from many manufacturers, and in kit form from several. If you assemble one yourself, use care in the soldering jobs. In sturmy weather, when you need it most, the reception is most difficult. So the more reliable the set, the better off you'll be.

BATTERY charger. I've never had the experience of pushing the starter button and being greeted by a long, dead silence. But I've been alongside luckless fellows who have.

As we add complicated electronic gear to outboard boats, then run the motors only a few hours a week, we greatly increase our chances of coming up with a tired battery. It's a simple matter to keep the battery in your boat up to snuff with a small charger.

The model I plan to have aboard next year, the Morse C-3, is a three-amp unit that works on either 6- or 12-volt batteries at the flick of a switch. It plugs into any 115-volt AC outlet, available dock-side at most marinas. It has a full-wave selenium rectifier, self-resetting overload cutout, and a heavy-duty transformer that tapers the charge as the battery approaches full capacity. A handy item to have aboard, and it can be used on your car in the winter.



W ORK-SAVERS.
Have you ever
noticed that "spitand-polish" Navy officers almost always
have someone else
doing the polishing?

Commanders

outboard boats must make do with limited and sometimes mutinous crews—and often end up doing the polishing themselves. Any chemical that reduces the need for this unpopular exercise is thus good news.

A glance through the pages of boatsupply catalogues such as that of the Crow's Nest will reveal several interesting-looking concoctions. Some of them promise to keep the bilge sweet and clean. Others, though called sail preservatives, are equally valuable to protect your canvas-covered life jackets from mildew. Still others act to prevent corrosion of metal fittings. A coating of vaseline will do wonders at protecting shiny cleats and other fittings.



BATTERY-POW-BER TV. At the start of this list, I said I hoped to put a "completed" check mark opposite each item by December 1. But this one might

have to wait till December 25.

I've hopes for a Sony—the world's most compact TV set. It weighs only 13 pounds and is entirely transistorized, with 23 transistors. It will operate on house current all winter. Aboard a boat, it operates on its own batteries (rechargeable) or on the boat's own 12-volt current.

Think back through your own experiences during the boating season just past. Jot down your own "Why didn't I?" list. Then work off as many of the items as you can before winter closes in. Come spring, you will be able to report your craft "in all respects ready for sea."

Fall Is the Time to Paint a Boat [Continued from nege 119]

mighty laborious job. Thorough sanding, though, is just as important as it ever was, so one should do this job with care. Use a belt or pad-type sander unless you're a real expert with the disk type. Use a dry brush and then a tack cloth (soaked in brushing thinner) to remove sanding dust.

'Then select your best paint from the chart. And make certain you observe the proper drying time between coats. This is one of the big advantages of fall painting—you have time to allow each coat to cure properly before adding another. An improperly cured undercoat of paint will be soft and will mar more easily upon impact. If you give each coat time to cure the way it's supposed to, you will have a paint film of maximum strength, ready to go the moment there's boating weather.—Jim Roe.

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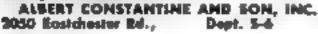
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Preview of the 1963 Outboards [Continued from page 114]

Speedifour with electric starting and regular shift. Electric shift remains available on the deluxe model. Also new is an optional hydraulic-electric tilt for the 75-hp, motors. This dash-controlled device can lift the engine to run in a tilted position for beaching or running in shallows. There's a radio noise-suppression kit, too.

The Scott line of McCulloch-built outboards maintains its range of 3%- to 75-hp. models and their unique features (from 7% hp. up) of automatic bailing and a

100.1 gas-and-oil-mix diet.

Power rating of the Royal Scott, offered with electric or manual starting, is up slightly—to 45 hp. Both Royal Scotts and the 75-hp. Flying Scott have shallow-water drive for operating in as little as six inches of water.

The alternator-equipped models of these again have the revolutionary surface-gap ignition that prevents oil fouling and gives a full season's use from one set of special

plugs.

Rumors heard last year about a little black box that would meter oil into the fuel haven't yet come true. My hunch is that they shouldn't be sold short. The gudget would end tank-mixing of oil and gas, could be used on almost any engine, and would be adjustable to deliver any oil proportion wanted. If it becomes available—probably not before mid '63—it will be as optional equipment.

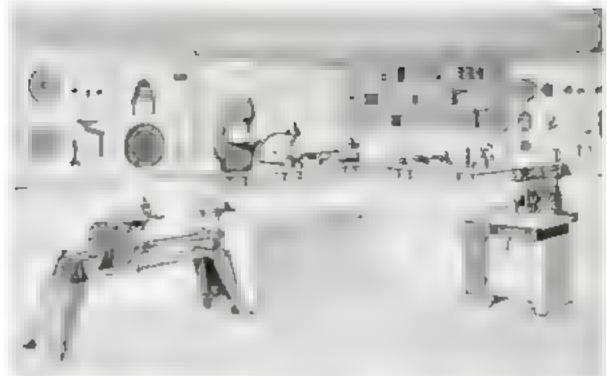
Perkins outboards, built in England by the world's biggest producer of compact diesels, are 4%-, 6%-, 18-, 30- and 40-hp. jobs. All have twin-cylinder, two-cycle power heads using a conventional oil-andgas mix. All but the smallest develop

maximum power at 4,500 r.p.m.

Surprising in two-cycle engines are the cam-driven poppet valves Perkins uses on 30- and 40-hp, models. Timing the intake only, they are a major reason, Perkins says, for the 40's high torque and starting thrust of 650 pounds. Opening the instant the piston moves in, they let the cylinder inhale a full fuel charge. Reed valves respond to crankcase vacuum, opening only after the piston has moved enough to create such a vacuum. The poppet valves also improve fuel economy, Perkins claims.

Built in Italy for Bundy Marine of Mountainside, N J., Bundy outboards were designed by European two-cycle experts,

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Preview of the 1963 Outboards

including some who created the Lambretta scooter. The keynote of these motors is simplicity; they were developed with an eye for the owner who has to do his own servicing. The 30-hp. model has only 620 parts—about half what others of that rating have.

Important parts are cannily shaped, sized or keyed so that they'll go in only the right way. Just four metric wrenches fit all bolts and nuts. But these seemingly austere outboards don't skimp on performance. For the second year, a 30-horse Bundy has been the only rig in its class to finish the tough Nine-Hour Endurance Race at Miami.

This Bundy 500 model sells for \$595 with electric starting, \$495 in the manual-starting version. New this year is the 18-cu-in, 20-hp, Bundy 300, with manual

starting only, at \$420.

Both are alternate-firing twins, and can be had with long shafts or short. The electric-starting model has a five-amp alternator on the same plate with a low-tension ignition magneto, dual breaker points, and condensers. The low voltage is stepped up in two exterior coils, one for each cylinder, an arrangement said to deliver a hotter sparking voltage at idling and so prevent fouling.

At Homelite, a spunky four-cycle challenges decades of two-versus-four-cycle argument. It was long said that a four-cycle's cam-driven valves wouldn't take long stretches of wide-open running. Firing only every other time around, a four-cycle would develop only about half the power of a two-cycle of the same displacement. Needing bigger or more cylinders for the same power, plus a camshaft, gears, pushrods, valves, and springs, the four-cycle would naturally have to weigh more.

The Homelite outboard gives some of these hoary notions the boot. With a displacement of 50.4 cu. in., it puts out 55 hp. at 5,500 r.p m. That's 1.08 cu. in, per horse, as good as some big two-cycle rigs. Nor is its tach red-lined. You can run it all out—yet it idles like a family sedan,

It's the advent of bigger boats, capable of carrying heavy engines, that makes this 227-pound rig practical. Although that's about as much as some 75-hp. two-cycles weigh, the Homelite's other advantages could tip the scales in many a boatman's mind. The exhaust is clean. Oil is not mixed with gas, but carried in a two-quart sump

Preview of the 1963 Outboards

and circulated by a gear pump. Oil con-

sumption is minute.

Gas economy derives from a basic difference between two- and four-cycle engines. In the two, intake and exhaust ports are open at the same time. Some fuel, and enough partly burnt oil to tinge the air blue, scoot out with the exhaust. In the four-cycle, fuel is jealously chambered where it can't do anything but burn.

The motor's nickel-iron block is east with the head; there is no head gasket, Bore and stroke are 2% inches by 2% inches. Compression is 9:1, yet the motor can use 80octane gas.

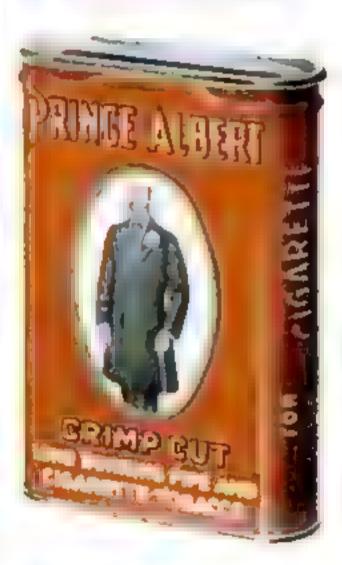
The crankshaft has five main bearings. Overhead valves are nudged directly by an overhead camshaft, driven by a tower shaft through bevel gears.

How do they achieve that 1:1.08 powerdisplacement ratio? Homelite credits it largely to dual carbs, friction-free manifolding, and an underwater exhaust system that induces a partial vacuum in the shaft housing at high speed. The modest Crosley's offspring has come a long way.

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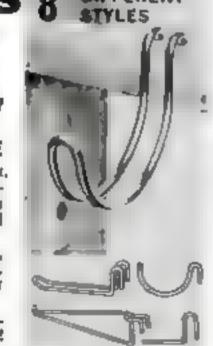
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Behold the Trigible!
[Continued from page 63]

With Aereon III this problem of range limitation is solved by "thermal lift." For the nose-up maneuver, the ship is lightened, not by dumping ballast but by heating the helium; for nose-down, the helium, instead of being valved off, is cooled, becoming "heavier." Helium temperatures are controlled by an internal heating system and a series of cool-air blowers.

It's a flying wing, too. The Aereon's three rigid airship hulls (each 83 feet long and 17 feet in maximum diameter) are connected by transverse truss members. Spaces between the hulls are filleted with faired structures of airfoil section—making the craft a buoyant flying wing. A double skin covers the duralumin-tubing framework, which is half as heavy and twice as strong as the structural material in the ill-fated Hundenburg. [See PS, May '62, "The Biggest Birds That Ever Flew."]

The outside hull skins (and the helium cells) are Dupont Tedlar; the inner skins, doped rip-stop parachute nylon-with a one-inch air space between for insulation.

Tedlar is a new material which Fitz-patrick considers ideal for airship construction. A polyvinyl plastic film, one mil thick and weighing only 6/10 ounce a square yard, it is strong, nonflammable, and highly impermeable. This leakproof quality keeps down loss of helium from the gas cells and of pressurization through the hull skins. The material also is impervious to attack by mildew or bacteria; holds its tensile strength through a wide range of temperatures; is not affected by moisture; and, being white-pigmented, needs no paint.

"This gives us a big bonus," Mr. Drew pointed out. "We don't need a large, expensive airship hangar. We just land and park."

Here another innovation comes in—a slick but simple built-in mooring mast. Remember the old newsreel scenes of a big dirigible landing, with an army of

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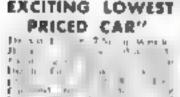
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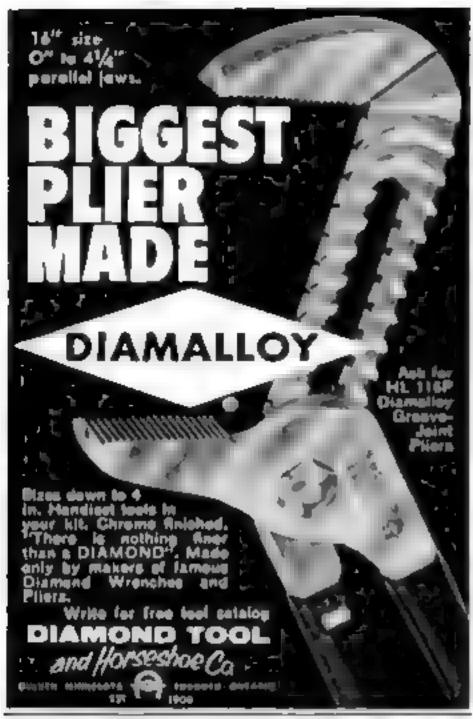
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men manhandling the huge bag to a tall mooring mast? Such landing requirements would defeat the goal Mr. Drew foresees for future, 1,000-foot, 100-toncargo-carrying, \$4,000,000 Aereons: transporting complete missions, hospitals, and schools to underdeveloped countries where any handy open area would be a landing spot.

The Aereon's mooring mast is its telescoping front landing gear, the strut of which extends into the interior of the middle hull where stresses are distributed. Just above the wheel is a swivel ring with holes in it for treing the ship down-leaving it free to swing with the wind or jockey up and down. A further mooring advantage: On the ground, with its helium cooled, the ship has positive weight rather than equilibrium.

The helium-40,000 cubic feet of it. contained in 18 cells, six inside each of the hulls-is heated by individual pro-

pane burners.

The controls. The nose wheel is not steerable, but the two rear wheels, below the outer hulls, are. Chains connect them to the rudders, which are controlled by the pilot from the two-man cockpit in the nose of the center hull. Also at the rear, between the hulls, are elevons (elevator-ailerons) for controlling the ship's nose-up, nose-down attitude.

For level flight, without using the gratis up-and-down gravity power, Fitzpatrick depends on his compact 61pound, 80-horsepower Solar Titan gasturbine engine. Speed: 60-70 miles an hour. Through reduction gears, the engine drives a rear-mounted, 21-foot, cyche-pitch, reversible, two-bladed helicopter rotor revolving in the vertical plane. Why a rotor instead of a conventional airplane propeller? It gives higher efficiency at low speeds.

The rotor does triple duty: propulsion, of course, but as an aid in steering as well-and for boundary-layer control.

The boundary layer is air that tends to cling to the skin of any aircraft, creating drag much as mud clinging to

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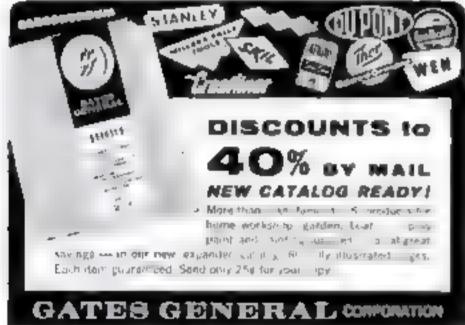
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Behold the Trigible!

your boots will when you're walking through a bog. Fitzpatrick counts on his spinning rotor blades to suck off the hitchhiking air and blow it away.

Faith and \$100,000. Drew and Fitzpatrick don't claim to have all the answers to lighter-than-air flight. But they hope to get them from flying their trigible laboratory, built on faith and practical knowledge—backed by more than \$100,000 from hard-headed businessmen.

How did these two men, the mild-mannered minister and the aggressive, chain-cigar-smoking aeronautical engineer, over get together? In 1958 Chaplain Drew, already deep in research on airships, was assigned to reserve duty with a Navy air squadron at McGuire Air Force Base in New Jersey.

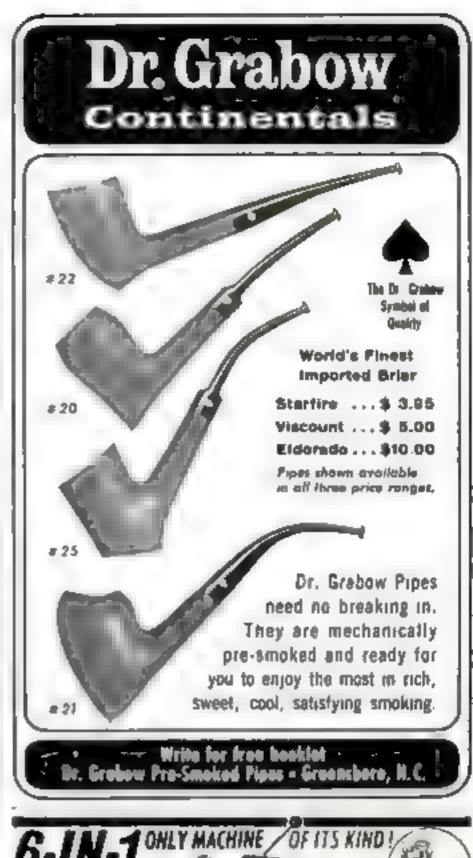
There he met Lt. Cmdr. Fitzpatrick, fresh from an epic flight in the Navy airship ZPG-2 he had planned: across the Atlantic, halfway down Africa, back to the coast of South America, and up home to Key West-11 days, 9,200 miles without refueling—a feat that won avia-

With nuclear engines? The two saw eye to eye. Fitzpatrick knew that the Navy had made up its mind to phase out lighter-than-air ships, so he saw no point in butting against a Navy wall of indifference as Dr. Andrews had that of official Washington 100 years before. But he visualized commercial possibilities—perhaps revolutionizing air transport with 1,000-foot cargo-carrying Aereons powered by nuclear engines.

They made a pact: Pilot Fitzpatrick, who was about to retire (he entered the Navy at 17), would join "sky-pilot" Drew in a brave, new air venture.

So the Aereon did not, after all, die with Dr. Solomon Andrews' disappointments. And there is something else of the industrious doctor in the reborn Aereon III—a bit of his philosophy:

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Tune in Radar on TV [Continued from page 86]

FCC has licensed to the Coast Guard for the unique experiment called RATAN (Radar and Television Aid to Navigation). The panel show was replaced by a picture few people have yet seen on TV: a bright map of the outer harbor, from the Narrows to Sandy Hook.

The approach lane from the Atlantic -Ambrose Channel-was laid out as plainly as a garden path. What's more, the map was animated. Swimming steadily up the buoy-lined path toward the Narrows were several white polli-

wogs with tapering, fading tails.

The skipper tapped a fingernail on the screen to indicate a smaller, south-swimming polliwog just emerging from the Narrows. "That's us," he announced "The others are incoming ships." He squinted out toward the open sea, then pointed. Far off the port bow, a big freighter had popped over our horizon. As she bore down on us, we checked her progress on the screen until her polliwog swam on past ours. Even in peasoup fog, we could have easily maneuvered out of her way.

The object of RATAN is to make just such checks possible aboard ships without radar. If the system is put in general operation, a small-boat navigator in busy harbors will soon be able to maintain a continuous position fix with respect to buoys, land masses, and movements of nearby vessels. If he loses track of his own blip on the screen, he can locate it again by going through a maneuver (such as a broad turn) and picking out the blip that responds.

What happens when he sails off the picture? He dials another channel—and watches himself sail into that picture.

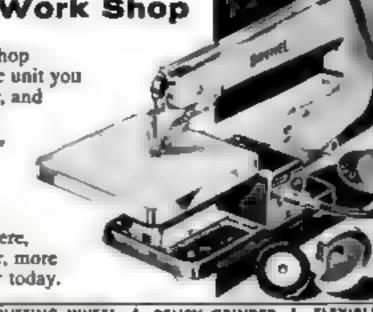
The TV radar picture is as stable as a map. The coverage and scale (usually about six miles) are determined at the transmitter, the Coast Guard Lifeboat Station at Sandy Hook, N.J.

The big advantage to the small-boat owner is cost: For the price of a television set with UHF-under \$200-he gets the equivalent of a \$2,500 radar.

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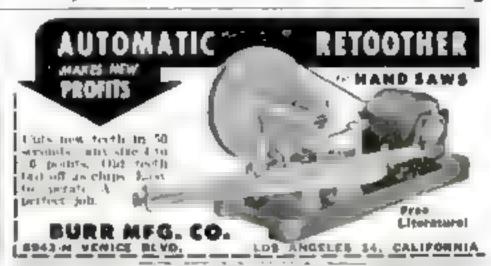


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Caddy Produces a New Engine

Continued from page 90,

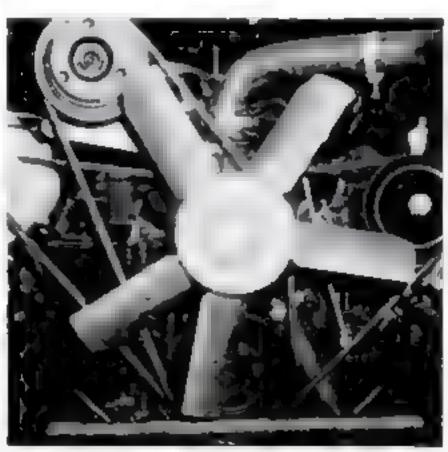
refinement for the new model year. Brake cylinders have been fitted with sintered-iron pistons to fight corrosion. A backing plate has been added to the front-wheel brakes to improve sealing in wet and dusty driving. Rear-wheel bearings have special seals to retain their own lubricant.

Cadillacs are about an inch longer than last year, a fraction of an inch narrower. Wheelbase is unchanged at 129.5 inches on 60-series models, 149.8 on the 75 series.

New models are cleaner in line. Fins, first introduced by Cadillac, have receded. For what it may mean, if anything, to a change of the Caddy "image," the word "massive" is missing from the press literature.

Hood and front fenders are split-leveled in a move away from the table-tennis-court design. On two models, the Coupe de Ville and 62-series coupe, the Cinemascope rear window is gone. It's smaller. Adds prestige, they say. The instrument panel is closer to the driver.

Most interesting among the new options is an AM-FM radio, with provision for a stereo-multiplex adapter, and a sixposition steering wheel.



Centrifugal viscous clutch, aluminum-cast, is mounted at end of concentric shafts to save space, eliminate bearing supports Uneven spacing of fan blades cuts high-speed noise.

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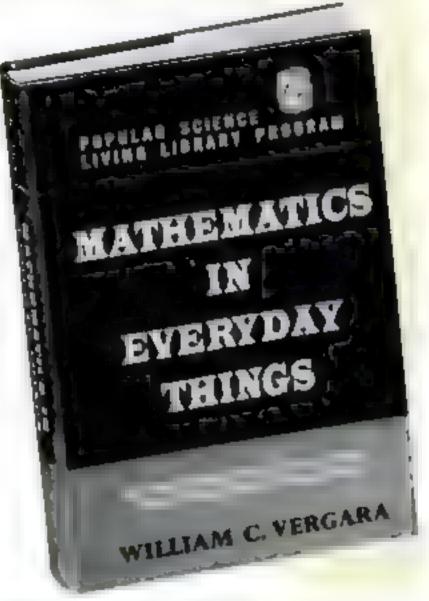
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Wire these parts as shown in the diagram. They fit into a recess in the left-hand upright, formed by jigsawing cutouts in the plywood layers. The aluminum-bar electrodes are connected to the power leads by two brass-rod terminals that extend through holes from the top of the left-hand upright into the control-compartment recess.

Copperplating most base metals involves cleaning the work to be plated carefully and suspending it in a copper solution on wire hung from the plating rack's cathode bar. Sheet copper will serve as an anode.

Cleaning is the crucial step, for any grease, oxide, or scale on the work may prevent the deposit from adhering. One easy way to clean an object for plating is to polish it with very fine grit abrasive cloth on a flexible disk sander. Then scrub it thoroughly with grit-soap suds (Lava soap) and household detergent. When the metal is spotless, dry it with a soft cloth. Avoid touching the surface—even a greasy fingerprint can cause trouble.

After providing a wire hanger, dip the object momentarily in dilute sulfuric acid —28-percent-strength, dry-charge battery acid. Then turn on the plater and lower the work into the copper bath. There's no shock hazard at the low voltages used

A pinkish copper deposit forms immediately. Should it turn mottled brown, too much current is flowing—adjust the rheostat for lower amperage. Voltage isn't critical. A little experimentation will determine the best rheostat setting for fast, smooth plating. It will take perhaps a half-hour to plate on a heavy layer of copper.

When plating a thick copper deposit, lift the work from the bath occasionally and smooth off any roughness with very fine wet-or-dry paper. Then replace it in the tank, Agitate and turn it now and then.

Plating iron or steel in an acid copper bath requires special procedure. If ferrous metal is plated directly, the deposit will be spongy and nonadherent. Before coppering steel, therefore, first give it a flash platea very thin coating—in an acid nickel solution. And before you flash it, etch the steel anodically to make the nickel adhere.

Anodic etching is accomplished by hanging the work from the plating rack's anode bar in a tank of battery acid. Use scrap copper for a cathode, and turn the rheostat to increase amperage until gas bubbles vigorously from the immersed steel. The bubbling will float off dirt and oxide, and the etched steel will take on a silvery mat surface. This may take five or ten minutes.

Then rinse the work, transfer it to the nickel bath, and flash-plate it for two or three minutes at low current density. After this flashing, the steel is switched to the acid copper bath and plated with as heavy a copper deposit as desired.

Nickel plate is ordinarily deposited over a thick copper underplate. This underplate should be polished smooth with wet-or-dry paper and pumice.

If the current in the nickel tank is too strong, gas bubbles from the cathode and the deposit turns duil gray. If the current is too weak, the deposit will flake off.

While nickel adheres well to copper, it doesn't adhere well to nickel. Therefore, be careful not to interrupt the flow of current. Don't remove the work for examination and, when turning it, avoid breaking contact with the cathode bar. For top protection against corrosion, build up a composite plate with alternate layers of copper and nickel, finishing with nickel

Zinc plating baths are handled much like acid copper baths. An acid zinc bath, however, is less able to plate into recesses. Turning the work frequently helps.

Nearly any nonmetallic object can be plated successfully if first brushed with an electrically conductive paint, as shown in a photo. The popular trick of plating baby shoes, pine cones, and other nonmetallic objects can be done this way. Use this same technique to electroform intricate parts. Make a plaster negative mold, give its face a conductive coating, then build up a full copper deposit.

Chrome plating requires special equipment. You can plate precious metals with your rack, however, using Pyrex coffeepot bodies for tanks and solution concentrates from a jeweler's supply house. Because the solutions contain cyanide, follow the instructions on the labels to the letter.



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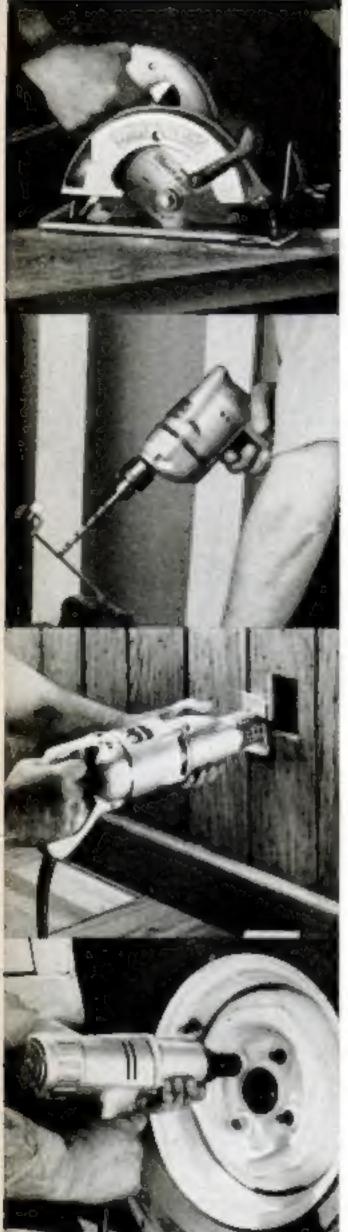
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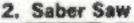
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